DEVELOPING SUSTAINABLE PRODUCT SEMANTICS FOR CONSUMER PRODUCTS: A SUSTAINABLE DESIGNER'S GUIDE

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THE CONVERGENCE OF SUSTAINABILTY AND PRODUCT SEMANTICS IN PRODUCT DESIGN

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To my parents, Jim and Sharron,
as well as my husband Richard,
whose boundless faith and support in me
are at the heart of all my accomplishments.

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SUMMARY

The purpose of this research is to understand and develop the relationship between product semantics and sustainable product design. *Product Semantics* refers to the features of a product that communicate its use, the audience the product is designed for, and emotional cues that the designer wishes to incorporate into the product. *Sustainability* refers to products or services designed in such a way that they do not negatively impact the environment, general human health and welfare.

The research activities investigate where the fields of sustainability and product semantics merge, and seek to understand what mechanisms will allow a product designer to incorporate details, forms, and materials into their design that will communicate the sustainable attributes of the product to consumers. The end goal of this thesis research is provide the sustainable designer with tools they can use to communicate sustainable design. More specifically, this thesis seeks to establish a set of design recommendations for designers who seek to communicate the sustainable attributes of products they design. This research develops a methodology which may be used to distill the sustainable attribute from products in a way that they may be applied to other products by sustainable designers.

CHAPTER 1

INTRODUCTION

The dawn of the Industrial Revolution was a pivotal era in human history, one that propelled humankind forward from agrarian communities into the largely urban societies that define the Western World as it exists today (Hooker 1996). The mid 1700s marked the Western movement from a localized agrarian economy to a distributed industrialized one; household industries that provided subsistence level goods gave way to large scale manufacturers that provided a surplus of goods. This shift encouraged lower costs and higher levels of consumption. The advent of widely available energy sources also encouraged new, more efficient machinery for manufacturing, mass production of goods, and a population boom that filled the factories and retailers. Along with these great accomplishments came other hallmarks of Western civilization: increases in urban air pollution, urban sprawl, and an unprecedented consumption of natural resources (Hooker, 1996). At the time, people tolerated these unpleasant side effects as the price of prosperity. These individuals ignored pollution and environmental degradation until the problems became lethal, or simply moved to another area to avoid the deleterious effects. (Encyclopedia of Sustainable Development 2001) However, as populations have increased across the world and in their turn moved towards the industrialized model set by Western countries, these 'unpleasant side effects' have multiplied and increasingly presented themselves as a serious problem, one that is no longer possible to ignore.

As the negative effects of the Industrial Revolution blossomed over Western Europe, the counterpoint of the environmental movement began to emerge, but did not gain international recognition until the mid 1900's. The environmental movement started out

as a backlash against localized problems, but as groups grew larger and problems spread the movement became a global one; eventually, groups merged and began to address issues that affected the entire globe as well. Some well known environmental activist groups, such as the Sierra Club, started as far back as the mid 19th century, but these groups now campaign all over the world against activities that are harmful to the environment and have endeavored to raise public awareness about environmental problems (Encyclopedia of Sustainable Development 2001). As environmental problems have escalated to a global scale, governments and global interest groups have also shown activity. The first national Earth Day was held in 1970, and was part of a response to a nation-wide grassroots campaign for environmental issues (Nelson, 2005). Two years later the United Nations' Conference on the Human Environment was held in Sweden, and was the first major international debate about the relationship between humans and the environment (Federal Office for Spatial Development 2004). Understanding of humanity's relationship with nature has certainly changed over the course of history. It has evolved from the imperialist belief that the Earth is a limitless cornucopia for man to subdue and mold as he sees fit, to an understanding of local resource conservation, on to a global understanding of man's need to adapt to a sustainable lifestyle to ensure the survival of future generations. As this understanding of environmental problems has continued to evolve, so have the solutions that man implements to combat them.

One ideology that evolved from environmentalism is the idea of sustainability. Sustainability was defined in its seminal form in the late 1980's (Brundtland et al. 1987). Sustainability is fundamentally different from environmentalism in that while it considers environmental integrity as one necessary part of the equation, it is not focused solely on

environmental concerns but also the integration of economically feasible and socially equitable solutions. Sustainability addresses the challenge of leaving resources for future generations while striving to maintain meet the needs of the current population. While the literal implementation of sustainability is impossible under the current production paradigm, the implications of this philosophy resonate into the very core of our conspicuously consumptive lifestyles and into the collective history of consumption. The ideals of sustainability take us back to the Industrial Revolution and beyond, to the birth of agriculture itself (Lumley and Armstrong, 2003). Yet the basic premise of sustainability reminds us that it does not seek to threaten industry and our way of life, but to transform them both. There are many opportunities for improving the human condition by eliminating the negative aspects of the Industrial Revolution, namely minimizing unsustainable consumption patterns, monitoring population growth, reducing pollution, and promoting human rights (United Nations, 1992). It is an opportunity to look back, past the smokestacks and fields of grain, to realize and remember what every other living thing on the planet already knows: living within sustainable, natural systems is the only way to ensure our continued survival and well being.

Along with the revelation of humanity's need for sustainability comes the realization that this transformation is both profound and challenging. For sustainable practices to be most successful, they must be accepted by everyone, from the individual to corporations to governing bodies. However, it is critical that certain groups spearhead the movement towards sustainability. A vast amount of waste and pollution occurs both directly and indirectly from the production and consumption of goods, and therefore this is a key area where change must occur. The main stakeholders in the consumption cycle are manufacturing and business, designers, and consumers (see Figure 1). While the

production process consists of these main stakeholders, this process does not occur in a vacuum; external factors such as government policy, advances in technology, and the current state of the environment also affect the process in significant ways.

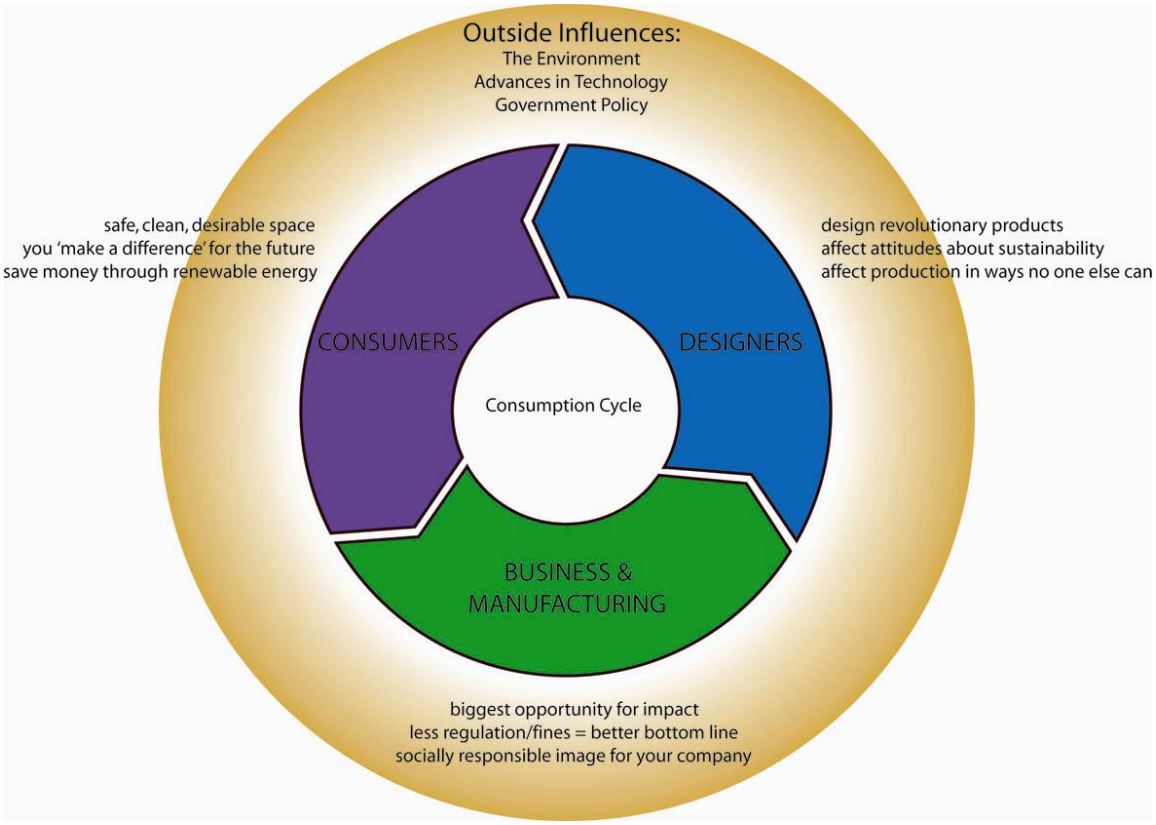


Figure 1. The Production – Consumption Cycle and Incentives for Sustainability

The three main stakeholders in the production – consumption cycle each feed into each other, propagating the cycle, while the outside influences can affect any of the stakeholders' positions. Business and manufacturing apply to designers to design products they believe consumers will buy. Designers meet the materials and functional

specifications of the intended product while also considering the personal needs and wants of the consumer, the end user. Consumers make purchasing choices based on the functionality, aesthetics, and business reputation of products, and the money from their purchasing choices goes back into business and manufacturing to fuel the production of new products. There are many places within this cycle to start enacting change; development of new materials and manufacturing methods, making a business case for sustainable design in the corporate sector, or applying to the customer directly. There is also the industrial designer, who holds a unique perspective and role in changing the consumptive cycle.

As a profession borne of the Industrial Revolution, it may be argued that the profession of Industrial Design has played a major role in the establishment of our current system, and has an opportunity to help mold the current consumptive cycle into a sustainable one. Victor Papanek delivers a scathing criticism to the field in his 1971 publication, *Design for the Real World*, stating that 'there are professions more harmful than industrial design, but only a very few of them'. He emphasizes the industrial designer's responsibility for his creations, and goes on in later works to detail the role of designers, bringing to the fore the challenges that they face in today's damaged world (Papanek, 1995). There are many challenges the sustainable designer must face. Fundamentally, they are responsible for traditional product design that provides a desired function with close attention paid to the needs and wants of their users. If this basic goal is not achieved, then the design itself is little more than a styling exercise, and only adds to the growing tally of frivolous artifacts which designers must be ultimately responsible for producing. Furthermore, as a sustainable designer, they must navigate a complex field of materials, design methodologies, and semantic communication, all of which are in the

initial stages of development. The protean nature of sustainable design as it stands today is both an advantage and obstacle to those wishing to practice it; while new technologies and materials are constantly being developed, it would still take many years to catalogue and quantify current technology and materials so designers might make informed choices about the elements they should use in designing sustainable products. There are other more subtle challenges to the designer as well; the design process rarely, if ever, occurs without the designer's goal being influenced by other groups such as engineers, management, and marketing interests. While these contributors may act to support the designer's goal, they often have agendas and priorities that may dilute or destroy the designer's original intent (Krippendorff and Butter, 1984). One large hurdle is the lack of consumer understanding of sustainability itself; studies have shown that the majority of the consumer population doesn't recognize the term at all (Vermeir and Verbeke 2004). Many people that understand the term sustainability associate it solely with environmentalism. This does not accurately represent the movement and carries negative connotations to some consumers. The responsibility of the sustainable designer is to communicate the value of sustainable design to all the other stakeholders in the consumptive cycle in ways that will make them receptive to sustainable products and will encourage them to adopt sustainable options as well as communicate the values of sustainable practices to others.

The goal of this project is to concentrate on the relationship between the designer and consumer; specifically, how the designer can communicate the sustainable attributes of a product to the consumer through attributes that have been designed into the product. This project will examine current consumer attitudes and perceptions about products designed with sustainable intent to determine which aspects of these products have

positive or negative connotations, and why these connotations exist. By examining product attributes that consumers accept or reject, it may be possible to establish a sustainable design vocabulary or document trends in sustainable products that are more acceptable to consumers. Using theories from product semantics, various sustainable product characteristics will be tested, from materials to emotional associations, to develop a set of recommendations for the industrial designer. These recommendations will be formed so that the designer can use them to communicate the value of sustainability to consumers through design.

CHAPTER 2

LITERATURE REVIEW

2.1 - A BRIEF HISTORY OF SUSTAINABILITY

Although ideas about limited growth and the need to carefully handle natural resources emerged as early as the mid 1700s among Victorian era philanthropists, the first definitive statements regarding sustainability did not develop until the late 1900s. The concept of sustainability first surfaced as sustainable development, presented in the Brundtland Report, alternatively entitled “Our Common Future”. Commissioned by the World Commission of Environment and Development, this document defined sustainable development as “meeting the needs of today without compromising the ability of future generations to meet their own needs” (Brundtland 1987). This initial definition of sustainable development was quickly embraced and five years later expanded in Agenda 21, a United Nations conference about environmental and social issues. The United Nations defined sustainability as a threefold responsibility: the maintenance of the issues of environment, economics, and equity (United Nations 1992).These three concepts can be approached as a burden or opportunity. When viewed as sustainable incentives, these concepts can be broken down into environmental stewardship, economic opportunities and rewards, and social responsibility (see Figure 2). In the case of environmental stewardship, there are many benefits that are derived from careful management and study. New discoveries in medicine, design inspiration from fields such as Biomimicry or natural geometries, and the ability of the environment to absorb and counteract our impact all come from having diverse and mature ecological systems. These opportunities can be lost without proper management (U.S. Global Change

Research Information Office, 1997). The economic opportunities from sustainability also come from a shift in perspective. Instead of viewing environmental regulations as an impediment, businesses can rework their philosophy and production processes to turn those regulations into opportunities. An example of this proactive philosophy may be found with Interface, Inc.; they found that introducing sustainable business practices reduced overhead in a variety of ways, from reducing waste (and therefore materials cost) to reducing or negating regulatory fines (Interface Inc., 2006). Sustainability also provided an opportunity to be socially responsible; in adopting sustainable practices one not only acts as a steward of one's own belongings but as a steward of the community and the world. Studies indicate this idea is also becoming attractive to businesses, who wish to show consumers that they are socially responsible (Grow, Hamm, and Lee, 2005). These three areas of responsibility combine to form a positive perspective for sustainability in today's society. This concept of sustainable development swiftly evolved into the much broader notion of sustainability, which applies to all aspects of modern culture:

> *Sustainability is an economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations. It can also be expressed in the simple terms of an economic golden rule for the restorative economy: leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do.*
>
> *- Paul Hawken, The Ecology of Commerce (1993)*

Although still very broad, Hawken's definition distills the idea down into a concept that is compelling to individuals, business, and government alike. These definitions are the refinement of a concept that can be applied to any and all aspects of modern life, which is the next step in the process to reclaiming the integrity of our future.

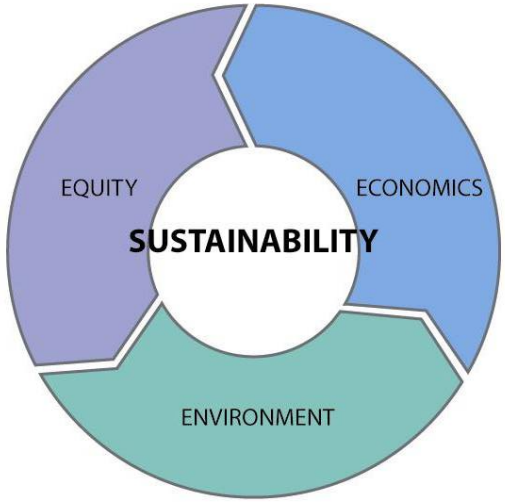
Integrating sustainable practices into society requires participation on all levels. Sustainable practices may occur within an individual's lifestyle choices, agricultural methods, architecture, public policy, technology development, or manufacturing methods. Individuals need to scrutinize their lives and how they might practice sustainability; again, one obvious place to begin this scrutiny is a process that encompasses the vast majority, if not all, of modern Westernized society – the process of goods production and requisite consumption. For man to extricate himself from this degenerative cycle, he must examine each stakeholder in the process to understand their contribution and how they may pose an obstacle – or become the catalyst for change – in the wasteful system of modern consumption.

SOCIAL RESPONSIBILITY

Taking responsibility for one's own impact lowers the global impact one person at a time

Sustainable practices allow people to be socially active not only on special occasions but in every day life

By helping developing countries develop sound sustainable practices we can help them avoid the current unsustainable practices of developed nations.



ECONOMIC OPPORTUNITIES AND REWARDS

Sustainable business practices can:

Reduce costs associated with waste

Cut down on the number of environmental fines that a company must pay

Gives the company the opportunity to present themselves as a socially responsible body

ENVIRONMENTAL STEWARDSHIP

Biodiversity maintains our potential for new medical discoveries

Preserve our inspiration for Biomimicry

Environment retains resiliency

Figure 2. Agenda 21 Definition of Sustainability Presented as Incentives.

2.2 - BUSINESS AND SUSTAINABILITY

One of the areas the sustainably-minded individual may integrate sustainable practices into today's consumption-centered culture is the business world. Indeed, there are many opportunities to promote sustainability in the corporate and manufacturing segment. Manufacturers use vast amounts of energy and natural resources to distill raw components into useful materials and products, creating a significant impact on the environment in the process (Hawken 1997). The corporate side of business is also closely concerned with consumer trends and desires, and therefore focused on making products they know will appeal to mainstream consumers. The business world can contribute to sustainability in many ways. Businesses may clean up their materials acquisition practices or encourage the development of sustainable policy decisions both within and outside of the company, or simply make sustainable products more available to consumers. These examples are all steps towards widespread sustainable practice. The key challenge for businesses is to determine where sustainability and profitability merge; while important as an ethical statement by companies, sustainability also holds opportunities for growth and profits that will help sustainable companies develop a competitive edge in both the short term and long term future.

There are certainly both challenges and incentives in applying sustainability to manufacturing and corporate interests. Manufactures will rarely change methods without impetus from other stakeholders in the production process; retooling and research for new materials and chemicals is both time consuming and expensive. Corporate decisions are often bogged down in the inertia of multiple levels of management and new ideas, viewed as a financial risk, receive even more skepticism (Cerin and Karlson

2002). However, the inertia of big business is not the only obstacle to sustainable manufacturing and business practices. Many businesses, like consumers, don't understand the concept or understand how it applies to them and their situation. Many companies that reject sustainability see sustainable business as a waste of time, or believe that adopting sustainable practices will only damage the bottom line (Smith and Weintraub, 1998). However, there are companies that find the benefits of sustainable business operations compelling as well. Manufacturers operating under sustainable guidelines reduce waste, often increasing the efficiency of their production and reducing their pollution output and the associated fines. Corporations are being pressured to be more socially responsible as well, and many use sustainable business practices to present a positive image to the public and their shareholders (PriceWaterhouseCoopers 2005). Many businesses that have chosen to follow sustainable practices have discovered, whatever their original motivation, that sustainable practices are actually an investment with both moral and monetary returns.

There are many ways that businesses can implement sustainable business practices, from the energy source they use to power their factories to their material choices to the processes they use to treat those materials. Some examples of companies that have integrated renewable energy into their business cycle are Patagonia, who purchases and generates renewable energy in the form of wind power, and Whole Foods, who purchases 100% of its power for its retail stores from renewable sources (Environmental Protection Agency, 2006). An example of sustainable material use comes from Rohner Textil AG, who produces a textile made with non-toxic dyes and natural fibers that can be composted, or rapidly biodegraded. Some companies integrated sustainable processes into their production cycle such as Interface Flooring, Inc. Interface, a carpet

manufacturer, changed from broadloom carpet to modular carpeting, also integrated a new dyeing process that allowed materials to be used more efficiently, and implemented a leasing strategy to reclaim old carpeting for reintegration into their manufacturing process. All of these strategies cut down on the materials used and the amount of waste product at the same time. While these companies all provide examples of how it is possible and productive to use sustainable practices in various areas of product, there are none yet that have managed to maintain a completely sustainable production cycle. However, more and more companies with sustainable agendas are emerging in the marketplace, providing more positive examples for sustainable business practice to consumers and their corporate peers. This movement has been complemented by a shift in the business world to accommodate and encourage sustainable business practices. Some examples include the Dow Jones Sustainability Index which tracks sustainable companies (Dow Jones Sustainability Indexes 2003), as well as investors who encourage the development of sustainable business and development by providing capital specifically for businesses with sustainable intent (Anderson 2005). Overall, there is an emerging trend towards sustainable production practices which is slowly changing the face of business.

2.3 - CONSUMERS AND SUSTAINABILTY

Consumers are the second set of stakeholders in the production cycle. Their continual demand for new products and consumptive lifestyle fuels industry to provide newer and better products which start the process over again. It can be challenging to reach the consumer segment; while one or two consumers may accept the tenets of sustainable living, their choices do not have the same magnitude of effect that a business accepting

those same tenets would have. Still, it is important to recognize that the CEOs are also consumers, and targeting the consumer population can have ramifications beyond that of individual opinion. Consumers also affect powerful incentives that exist outside the normal production cycle, such as political motivations and regulations. Papanek, a sustainable designer, also argues that while the environmental problems that have been created over the past few centuries are now global in nature, it is necessary to begin repairing the damage on a 'human scale' (Papanek 1995). He contends that large entities such as manufacturers and corporations are large and unwieldy, their very nature impeding their ability to change. The individual has a much faster response to change and the ability to swiftly alter their behavior and affect change. While individual contributions may seem small at the beginning, the choices of individuals are a necessary component to the acceptance and success of sustainability.

Convincing consumers to accept sustainable practices is a difficult and complex issue. There are many challenges and incentives in this area as well, which may cause consumers to accept or reject sustainability. Many of the challenges stem from a lack of knowledge on the subject; many people simply don't understand the term sustainability itself (Sustainable Development Commission, 2001), let alone how to practice it. Another challenge is the lack of sustainable options in the marketplace. Many consumers don't even realize they have the option to purchase sustainable products because sustainable products don't exist in the same volumes as their unsustainable counterparts. Even in Europe, where the use of eco-labeling is more prevalent than in the United States, there is still a problem with consumer education about sustainability (Sustainable Development Commission, 2001). Yet another barrier is the consumer's perception of their individual impact; many people don't understand that their contributions to waste,

pollution, and environmental degradation make an impact, or do not believe they have access to the necessary information to make the right choices (Jensen and Sørenson, 2003). Among consumers that adhere to sustainable practices, the main incentives that compel them are often economic or ethical, or both (Berman, 2006, Demerritt, 2005).

There are three main consumer segments with their own distinct characteristics regarding their attitude and behavior towards sustainability. The first group, which is adamantly non-sustainable, does not accept sustainability and often has negative perceptions about implementation. Neutral consumers believe that sustainability is a good idea, but do not actually go so far as to integrate the practices into their lifestyle. The final group of pro-sustainable consumers actively implements sustainability into their lifestyle and provides a view of what is possible in the future.

Non-sustainable consumers reject the idea for a variety of reasons. Many in this group simply lack the education and awareness to comprehend the issue properly and regards environmental stewardship as a vaguely formed idea, a problem someone else will handle. Another misconception is that when sustainable methods and materials are used in production the products are inferior in quality. However, as the palette of sustainable materials continues to expand, this perception is being negated. Some consumers also associate sustainability with environmentalism and radical conservation groups; however, research indicates that the majority of consumers profess concern for environmental issues (UNEP, 2004). While the objections non-sustainable consumers pose are indeed challenging, none of them are insurmountable.

Sustainably-neutral consumers are an extremely interesting group, in that they represent the majority. They profess concern for environmental issues and believe sustainability is a positive step forward, although they do not regularly purchase sustainable goods (UNEP, 2004). There are many reasons for this behavior-attitude gap. As with the non-sustainable group, one reason is the perception that sustainable product design is by necessity more expensive than the unsustainable alternative. While this may be true in the short term for some items, most of the added cost is due to the small market mass, not an inherent cost of sustainable production (California Waste Management Board, 2005). Many sustainable technologies, such as renewable energy technologies, are more expensive to implement at the beginning but over the course of their lifetime cost less than unsustainable options. Another reason that consumers don't purchase sustainable goods is simply because it takes more effort to search out and choose sustainable alternatives to readily available products. Again, this challenge is a result of the relative scarcity of sustainable products. Also, much like non-sustainable consumers the sustainably neutral consumer group associates sustainability with environmentalism and a sacrifice to their quality of life. There are already some solutions and market trends that combat these problems, and could already be contributing to the wider acceptance of sustainable design. For example, an expansion of government eco-labeling strategies such as Energy Star (US), Blue Angel (EU), and the EcoMark (JAP), may prove to spread understanding about environmentally friendly products and provide consumers with valid ways to discriminate in their purchasing. As far as the stigma of fanaticism attached to green purchasing, some current research in the field of architecture suggests that consumers are beginning to see sustainable design as a desirable aesthetic, and there is an emerging stigma attached to products that glorify consumption, such as large SUVs and oversized homes (Merrick 2005). Some neutral

consumers have tried sustainable products on a limited basis, and have been disappointed with their performance or quality. This issue is a critical one for industrial designers; designers can use their skills to provide sustainable products that both communicate quality and provide the function and durability that consumers expect (Dermirbilek and Sener, 2003). Sustainably neutral consumers are receptive to sustainable products because they believe that buying sustainable goods is a responsible and ethical practice, much in the same way they might believe that exercise is a responsible and healthy practice. It is critical to understand the needs and desires of this group, as well as the obstacles that keep them from accepting sustainability for sustainable initiatives to have the most impact.

Pro-sustainable consumers are representative of the behaviors and values necessary to integrate sustainability into the production cycle. While there is little research or material available that defines the sustainable consumer, according to some marketing studies by the Natural Marketing Institute there is a market segment with values closely aligned with those of sustainable consumers. This particular segment of consumers, identified by the term LOHAS (Lifestyles of Health and Sustainability), hold strong beliefs about human health, global issues, and sustainable living. Research indicates that LOHAS consumers represent a large portion of adults, up to 30% of the U.S. population (French 2004). LOHAS consumers , alternatively identified as *Cultural Creatives* in Paul Ray's 2001 text, are highly motivated to choose products that correlate with their lifestyle and personal belief system. To that end, LOHAS consumers actively investigate not only the products they buy but the companies that produce them, and are not easily swayed by marketing ploys or greenwash. To capture these consumers, businesses must honestly adhere to a sustainable philosophy and make a distinct effort to provide sustainable

goods and services. When businesses make the extra effort to reach LOHAS consumers, they are summarily rewarded; when a business promotes LOHAS values, LOHAS consumers become brand aware and brand loyal to that particular company, and are often willing to pay up to a 20% premium for their products (Everage 2002). An interesting quirk of LOHAS consumers is that they dislike being classified as such; many view themselves to be individualists that cannot be reduced down to a marketing statistic. Some key differences between LOHAS and mainstream consumers are that LOHAS consumers strongly believe that their personal choices affect the environment, and that LOHAS consumers are much more educated about sustainable issues. As more people become exposed to more sustainable goods and become more aware of sustainable issues and understand the language of sustainable consumers, it is possible they will follow the lead of the pro-sustainable consumer and begin to enact significant change.

While the sustainable consumer is at present a complex and under-researched market segment, there are indications that the neutral majority has many key values that make them receptive to sustainable products. Market research suggests that mainstream consumers are seeking a unique identity that is not fulfilled by current mass-produced goods. People want and expect items that identify with their personal beliefs, not just operate within accepted parameters. There is an identified consumer need to surround themselves with products that not only fulfill their needs but represent their values, status, and way of life (Dermirbilek and Sener 2003).This consumer desire resonates very strongly with sustainable ideals, and fuels the market for sustainable products, as expressed in current trends in organic food and hybrid vehicle markets (Shapin, 2006, Berman 2006). This increased interest leads to greater production runs, more R&D for

sustainable technologies, higher quality products, more information and sales. While the movement is still in its infancy, the ball has started rolling. Understanding the characteristics of sustainable consumers may motivate businesses into offering sustainable options for their market segment, thereby providing more choices and information for the mainstream consumer as well.

2.4 - SUSTAINABILITY AND DESIGNERS

The final stakeholder in the product cycle is the industrial designer. While manufacturing and business provide the materials and capital for production, the designer is a crucial link between the consumer and business, managing aspects of product design that "relate most directly to human characteristics, needs and interests" (IDSA 2006). A profession that is tied very heavily into manufacturing and mass-production (and consumption) of goods, industrial design has a unique relationship and responsibility to the consumptive cycle of production that has emerged. Choices that designers make in material selection, structure, function, and the semantic expressions of the product can greatly affect the sustainability of that product in ways that are not addressed in any other area of production. The acceptance of sustainable design as a part of industrial design culture is slowly taking hold, mirroring the pattern that occurred in its sister profession, architecture (Riccini 1998). Like architects, industrial designers are beginning to take responsibility for their progeny by making sure that this generation of products doesn't impinge on the needs of the next generation.

The sustainable designer has many opportunities to implement sustainable design in their products; they can integrate renewable energy technology, use sustainable

materials, or employ design methods that specifically affect the production processes or the final form and function of the product. There are a wide variety of design methodologies that are used to develop products with sustainable intent. Many design methods prepare the product for certain types of sustainable post-consumer processing, such as design for disassembly, design for remanufacturing, and design for recycling. These methods often focus on optimizing the product's construction so that the product can be taken apart, either to be refurbished or broken down into its constituent components to reclaim the materials or be recycled. Other design methods are used to optimize the sustainability of the product's manifestation, such as design for dematerialization and Biomimicry. These methods focus more heavily on the materials in the product and how they are used. Dematerialization involves using the least amount of material possible to provide the service of the product, while Biomimicry focuses on inspiration from material sources and processes found in nature. These methods give the industrial designer a broad spectrum of inspiration and design methods from which to devise sustainable products. This process works best when used hand in hand with industry and corporate support, but with this toolbox of methods, a designer can integrate sustainable methods into products, even if industry doesn't necessarily support their efforts. This is a case where one or two individuals may make a difference, affecting the environmental impact of hundreds, thousands, or even millions of products and the consumers that purchase them.

2.5 - A BRIEF HISTORY OF INDUSTRIAL DESIGN: THE DESIGNER CONSUMER RELATIONSHIP

In much the same way that the first significant movements involving sustainability can be traced back to the Industrial Revolution, Industrial Design emerged in the Industrial Age as well. Before the Industrial Revolution, the main conduits for product design and manufacture were through craftsmen, and all products were made by hand and many were made to order for their purchasers (Rempel 2006). Very little, if any, stock of products were kept by craftsmen; the products were made as needed. With the advent of new technology that allowed wide availability of raw materials and faster, mass quantity production, new paradigms arose in manufacturing. The craftsmen's skills were no longer needed; they were replaced by unskilled laborers that ran the new machinery. For the first time a wide variety of products appeared in stock, allowing for cheaper products and a larger market audience. As for the design of the products, another skill previously left to craftsmen, the product designs were heavily influenced by current handcrafted products as well as the technological abilities of the machinery. The first industrial designers appeared in this time as draftsmen, providing manufacturers with scale drawings for tooling and templates. These draftsmen, the first instance of an interface between manufacturers and consumers, were the humble beginnings of the Industrial Design profession (Heskett 2001).

As Industrial Design carved out a niche between the manufacturer and the consumer, the role of design in manufactured products began to evolve as well. While at the beginning draftsmen served the needs and expectations of consumers, fashion soon pressured manufacturers to redesign their products. Manufacturers then sought to

integrate the skills of the craftsman that had been neglected in previous products. They required design skills that could not be captured in the manufacturing process or by the uneducated draftsman: the art behind the craft. Up to this point, draftsmen relied on pattern books for inspiration; as fashion and consumer tastes changed, the pattern books of traditional designs became outdated. This realization marked the first introduction of classically trained artists into the industrial arena, who provided inspiration for forms and ornament which was then adapted by the draftsmen. At this point, while a few notable exceptions asserted themselves by innovation in both form and function, the role of the designer was relegated to that of a stylist without any real influence on the function of the product. Only the emergence of the Bauhaus movement in the 1930s did designers assert themselves as artisans, both with skills in craft and art. Bauhaus designers were functionalists, not stylists, and the functionalist mantra “form follows function”, is often applied to this era and continues to be used today. After this bold definition of the designer as both the product’s artistic and functional motivation, the designer became more influential in the total design of their products. Throughout the 20th century designers continued to expand the meaning and breadth of their arbitrative role between manufacturers and consumers. Other design theories emerged after that point which profoundly affected the role of the industrial designer; for example, the emergence of human factors and ergonomic studies during the mid 1900s expanded the role of the designer to encompass not only the function of the product, but its interaction and affect on human physiology as well.

As industrial design moved its primary focus from products to include the needs of users, many new theories emerged that allowed industrial designers to further expand their roles. Some theories, such as human-centered design, focus on the physical needs of

users and the tasks they perform with products, both of which heavily influence the product's overall design. However, another human focused design approach emerged out of an interest in how and why products were formed in the first place – the cultural implications and meaning of products and their forms. The field of product semantics emerged from this interest in the cognitive motivations behind product design. First explored in the Ulm Design School in the 1950s and coalesced into a discrete theory in the 1980s, the study of product semantics is a significant milestone in postmodern industrial design.

2.6 - PRODUCT SEMANTICS

The term 'product semantics' was first coined in 1984, in *Product Semantics: Exploring the Symbolic Qualities of Form* by Klaus Krippendorff and Reinhardt Butter. This essay reexamines the basic role of the designer, and describes design as 'the conscious creation of forms to serve human needs', and the field of product semantics as 'the study of the symbolic qualities of man-made forms in the context of their use and the application of this knowledge to industrial design'. Essentially, product semantics focuses on the significance of communication between the designer and the end user, and suggests that the product is the medium of communication. Derived from the field of semiotics, the study and applications of signs and symbols, product semantics presents a unique challenge in that all man-made forms have a long contextual history, and by their very definition cannot be semantically neutral. The designer's main challenge is to become aware of the signals that he conveys through product design, and his role and influence in the communication process (see Figure 3).

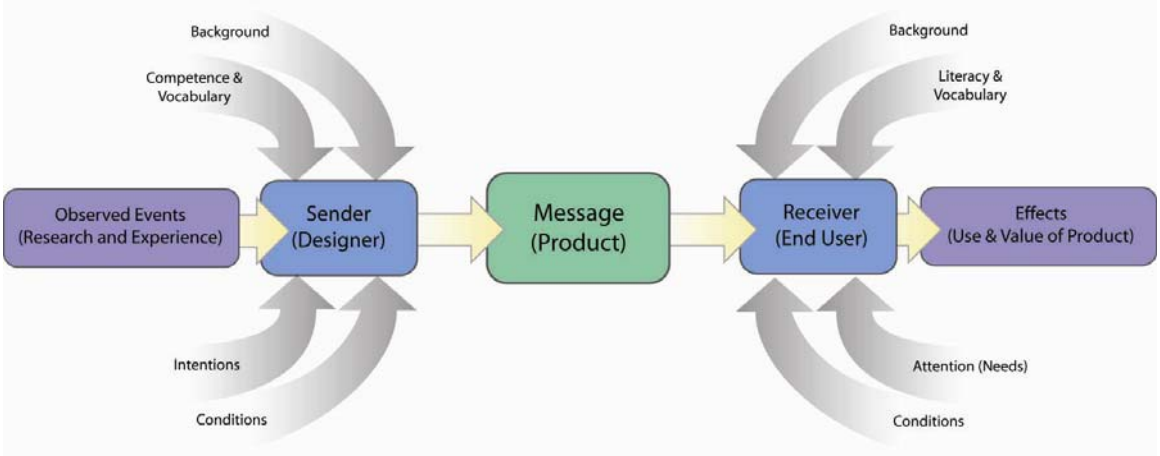


Figure 3. Communication between the Designer and End User (adapted from Krippendorf and Butter, 1984)

It is important to note that this communication is a two-way process. The end user can communicate back to the designer through both general and specific channels. General communication might include the acceptance or rejection of the end product, while specific channels of communication might include the consistent adaptation of the product for a specific task or need - not necessarily the need the product was designed to meet. For instance, a simple pocket knife may be appropriated for a variety of secondary tasks, such as prying open a container or tightening a flathead screw. While the strictly cognitive aspects of product design are well represented by this model, the emotional aspect must also be considered for a full picture. Donald Norman presents the idea of communicating the emotional aspects of a product to the user on three levels: visceral, behavioral, and reflective (2004). The visceral feedback and response is built on the appearance and first impressions of the product itself. Behavioral communication is the reaction the user experiences by using the product, while the reflective aspect of

the product is how the product appeals to the user's self-image, and how it represents an idea or value to the user. Product semantics is certainly a complex field of study, built upon cognitive sciences and thousands of years of human cultural development, but it is also a field that expands the scope of industrial design in ways never before imagined.

There are certainly many challenges facing the designer who focuses on product semantics. The main challenge, faced by all designers, is the designer's lack of control in the product design process. While this may seem antithetical, in reality the designer's communication to the end user is only one facet of a larger process, and the other communicating stakeholders may end up conflicting with the designer's message, or destroy it completely. As illustrated in Figure 4, the designer communicates to the end user along with sales and engineering, although their message is distorted by miscellaneous noise within the product design process such as production limitations or lack of resources. Each stakeholder has their own objectives for the realization of the product, not all of which reinforce the product designer's intended message to the user. Another aspect of the process outside the designer's control is the user's assimilation of the product, and the context in which they use it. Much like the users themselves, the context of use is very individual and while the designer may plan for the primary usage of the product, they can never fully encompass all possible scenarios of use and may not wish to (e.g., a shoe being used to hammer a nail). While this uncertainty may be combated by research, another challenge in the process arises from the way that semantic research must be performed. Often the product semanticist has little choice but to iterate the design and receive feedback from users and sales of the product until the desired effect is achieved. While effective in the long run, this method can be both time consuming and expensive. For a designer to resolve these issues, they must be

able to clearly identify their motivations for their design choices, and be able to find compromises with both engineering and sales concerns as well as the scope of their own knowledge.

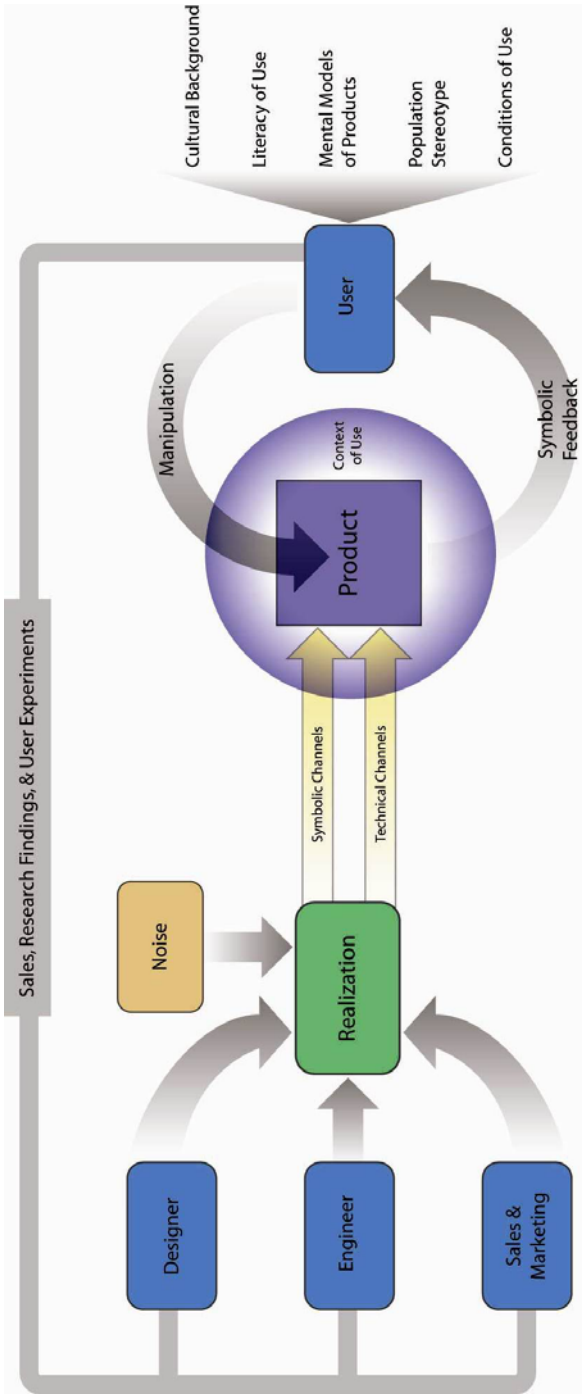


Figure 4. The Role of Various Stakeholders in the Product Design Process.

(adapted from Krippendorf and Butter, 1984)

Krippendorff and Butter predicted that product semantics would evolve into a field of empirical study, and so it has - one of the most crucial steps in designing a product around certain semantic goals is defining and testing those semantic properties. There are two major options available to product semanticists; either forming a case study around a specific semantic goal or applying directly to users through iterative focus group studies. The case study method involves examining products that align with a specific semantic goal and distilling down the elements those products have in common. For example, as in a 2003 study by Oya Dermirbilek and Bahar Sener, one might study products that focus on the conveyance of emotional content; in their case, happiness. This methodology also includes research into established cultural cues that trigger the desired response, (i.e., adapting imagery of children or baby animals to evoke positive emotions). Adapting these positive emotional traits and personifying them in a product often has powerful results; products which are perceived to have ‘faces’, such as automobiles, produce a strong emotional response and identification to the user (Welsh 2006). In such cases where strong personification is inappropriate or irrelevant, personifying cues can still be used, albeit subtly. This method presented by Dermirbilek touches upon some key elements of semantic development. Over the course of civilization certain imagery has appeared repeatedly, and has become so ingrained in man’s collective consciousness that he directly associates these cues with their original meaning, however they are applied in current context. For example, solid, bulky shapes often convey the notion of strength and permanence, even if technology allows for those shapes to be dematerialized. Taking advantage of those ingrained messages lies at the heart of product semantics. While the case study method is very effective in certain instances, when the designer wishes to convey semiotic messages for products that have little discernible precedent or the messages themselves are not widely used, the

iterative method is more appropriate. A strong case for use of this method occurs with the introduction of new technology or a radically different design of an existing product, both of which occur with the swiftly advancing technology trends of today. Robert Veryzer developed a methodology for evaluating the efficacy of the semantic message, as outlined in Figure 5 (1997). Veryzer surmises that the designer constructs a product that carries certain *attribute expedients* (AEs), which are terms that communicate a specific thought, detail, or concept. This communication comes across to the end users through these AEs as *perceived product characteristics* (PPCs), which are holistic impressions that compose the user's judgment of the product within their context of use. Veryzer identifies the key element in this process as the sentientality link, or the magnitude of correlation between the AE presented by the designer and the PPC understood by the user. In essence, this method of semantic study involves measuring how well a designer conveys his intended message, and modifying the design as needed to amplify or repress certain messages conveyed by the design. Applying the semantic knowledge gathered by either method can manifest itself in a variety of ways in the form, color, texture, or function of the product. Each has their own advantages and disadvantages, and applies to various challenges that arise in the application of product semantics.

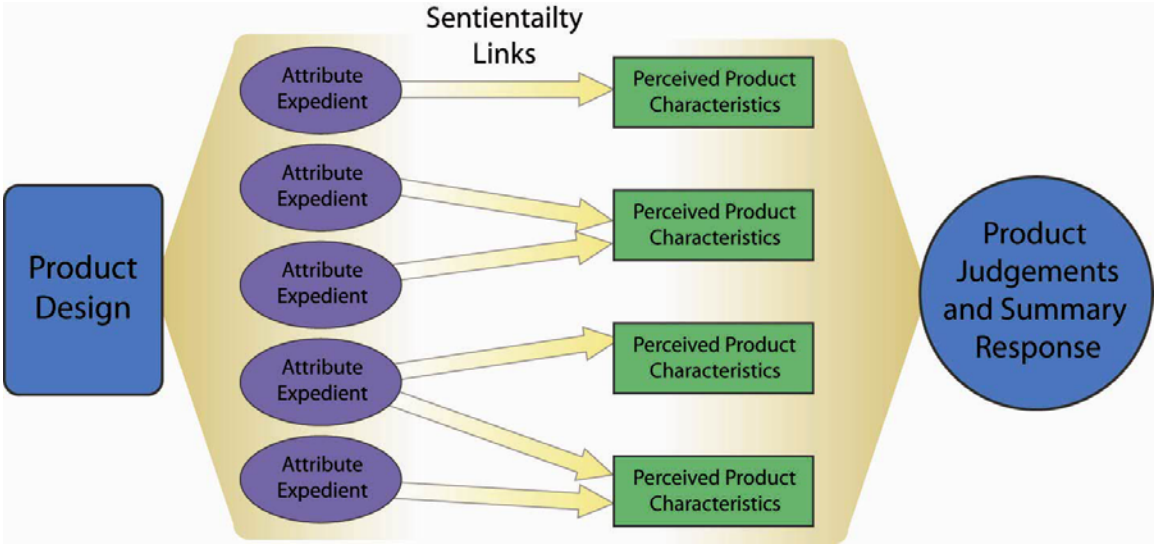


Figure 5. Interpretation of Product Semantic Communication (adapted from Veryzer, 1997)

Although product semantics is a relatively new field of study in the young discipline of Industrial Design, it is an undeniably powerful tool for communication. Trends in consumer purchasing indicate that current consumers have a strong desire for products that not only function well, but also emphasize the individual's beliefs and lifestyle choices (Dermirbilek and Sener, 2003). This desire can only be satisfied by the thoughtful application of product semantics; designers now need the ability to design products that communicate discernible messages to the end user as well as those around them. Product semantics has been informally applied to most products; indeed, it is impossible to do otherwise, given the pervasive nature of semiotics. However, often this application is muddled by other stakeholders in the process, limitations in the designer's own understanding, or unintended use of the product itself. A rigorous, thoroughly researched application of product semantics is required to address these

issues and provide semantic cues that will clearly convey the intended messages to a wide audience.

2.7 - THE CONVERGENCE OF SUSTAINABILITY AND PRODUCT SEMANTICS

At first glance, it may not seem like the design concerns of sustainability and product semantics necessarily relate to one another, but in fact the two fields complement each other very well. Both emerged from movements that began in the Industrial Revolution, but both also have roots that stretch back into the dawn of human culture. The communication of sustainable ideals is a very intriguing application of product semantics; as previously noted, while other applications might communicate an emotional or physical trait, such as happiness or strength, communicating the sustainable aspects of a product crosses many boundaries as yet unexplored. While happiness may be integrated into any product, imagine how much more compelling the semantic message can be when it is based in the actual materials and processes used to make the product. While emphasizing the strength and durability of a product may be key to it's success, integrating sustainability into the message conveyed by the product reaches into the sustainable consumer's powerful need and desire for products that represent their lifestyle and beliefs. These elements come together into sustainable product semantics to create an extremely powerful form language that could transform current standards of design.

While sustainable product semantics can be a potent means of conveying sustainable ideals to consumers, it is important to consider the challenges that arise from the nature and history of sustainable design. As mentioned previously, while the majority of

consumers accept sustainability as a good idea, the behavior-attitude gap exists because their interest doesn't extend to their pocketbook or sustainable products do not fit well into their current lifestyle (Demeritt 2005). Another problem is the negative connotations that stem from the environmental movement: the stereotype of the fanatical green purchaser and the opinion that sustainable products mean a reduction in the quality and fulfillment granted by the products. For sustainable product semantics to be successful, it is important to investigate the aspects of sustainable design that elicit positive reactions from consumers, while suppressing or negating the cues that bring forward negative reactions. These cues may be found in the processes, materials, or finishes used in the product, the final form they take, or even how they are used by the consumer.

One other interesting issue that arises in the discussion about sustainable product semantics is that of exploitation. *Greenwash*, the term used to describe misleading information about the environmental impact of products, has always been a problem in sustainable design. With sustainable product semantics, greenwash could be able to permeate consumer markets more insidiously than ever before. No longer relegated to marketing materials or labels on the product, greenwash could actually be integrated directly into the product itself, misleading the consumer in ways they wouldn't even consciously comprehend. This problem isn't new to the field of semiotic study; indeed, Umberto Eco, a prominent researcher in the field, once described semiotics as "the discipline studying everything which can be used in order to lie". However, he goes on to argue that this is an essential aspect to semantic representations, for if "something cannot be used to tell a lie, conversely it cannot be used to tell the truth; it cannot, in fact, be used to tell at all" (Eco 1979). So, while greenwash may occur, it is a necessary

evil. It may also be argued that greenwash as a marketing deception is less effective on the sustainable consumer, given the rigor with which they investigate the products and companies they patronize. Regardless, the formation of sustainable product semantics is important enough to warrant investigation from designers, even given the threat of misrepresentation by fraudulent parties.

At this point, the purpose of this research exercise is clear. Sustainability is an extremely important idea that needs to be understood and accepted by everyone, and the only way to really have an impact on the production - consumption cycle is to infiltrate the cycle itself, and enact change within the participants and their artifacts, products. Industrial designers are in a unique position to act as catalysts for this change; they have both the responsibility for their profession's damage to the environment and the skills necessary to move modern cultures into sustainable lifestyle habits, through product design that meets the consumer for lifestyle enhancing products. Research into individual attitudes and behaviors concerning sustainable issues is especially key for the designer, since much research in the area is based from secondary sources such as local and state government agencies, academic institutions or government databases (Hart, 1995, Harker and Natter 1995, Jones, 1990). By adapting current product semantic research methods towards understanding the semantic cues behind sustainable design, designers can create sustainable products that meet the consumer's needs and desires on multiple levels of consciousness. The next step in this process is to investigate current examples of sustainable product semantics, observe subjects' reactions to those semantic cues, and identify trends in sustainable semantics that can be given to industrial designers as a primer for sustainable forms, materials, and functions that have a strong positive resonance with the consumer.

CHAPTER 3: METHODOLOGY

3.1 - CONSUMER PERCEPTIONS OF SUSTAINABLE ATTRIBUTES: PURPOSE

The main purpose of this research exercise is to identify sustainable product attributes. Specifically, this exercise was developed to investigate what forms, materials, colors, textures, and other relevant product attributes that consumers believe represent sustainability. A primary goal in development was properly setting the scope of the project. Proper definition of scope is a key element of this research activity; it must be broad enough to identify design elements that can be used across multiple product categories but narrow enough so that generalizations across these categories can be made. To meet the overall purpose and meet the primary goal, the research instrument includes a general sustainability questionnaire, a brainstorming session, and a participatory research activity in which subjects evaluate multiple product categories for positive and negative traits. These three activities address the consumer's sustainable habits, their perception of sustainability, and finally their perception of various products and understanding of what attributes make up a sustainable product. By evaluating consumer perceptions regarding a wide range of products it is possible to develop a general understanding of product semantics that best communicate sustainability to the consumer and where they might be applied.

3.2 - CONSUMER PERCEPTIONS OF SUSTAINABILE ATTRIBUTES: METHODS

The research session consisted of a series of small-group sessions, with two to five subjects each. The sessions were approximately 90 minutes each, and during this time subjects completed a short questionnaire, participated in a short brainstorm activity, and completed three collage exercises (see Figure 6).

Each activity was constructed to reinforce the validity of the material collected from the other activities, in that some of the same queries were presented in different ways to see if the subjects would respond with consistent answers. The questionnaire, a short survey with a traditional layout and question structure, was developed with formal methods and acted as a control group for the information collected via the other two methods. The brainstorming session was brief and informal, but served its main purpose to stimulate the subjects into critical thinking about sustainability. It acted as a smooth transition from the formal method to a participatory research method, the collage exercises. The collage exercises made up the majority of the research content, and were constructed from basic theories about participatory research methods as well as drawing from other traditional research methods such as semantic differential comparisons and focus group-based discussion sessions. Finally, each subject's information was coded for anonymity before cataloguing and evaluation. By using a variety of research methods a broad range of information was collected from subjects while still probing for detail in critical areas; this combination of methods also allowed for cross referencing data for validation purposes.

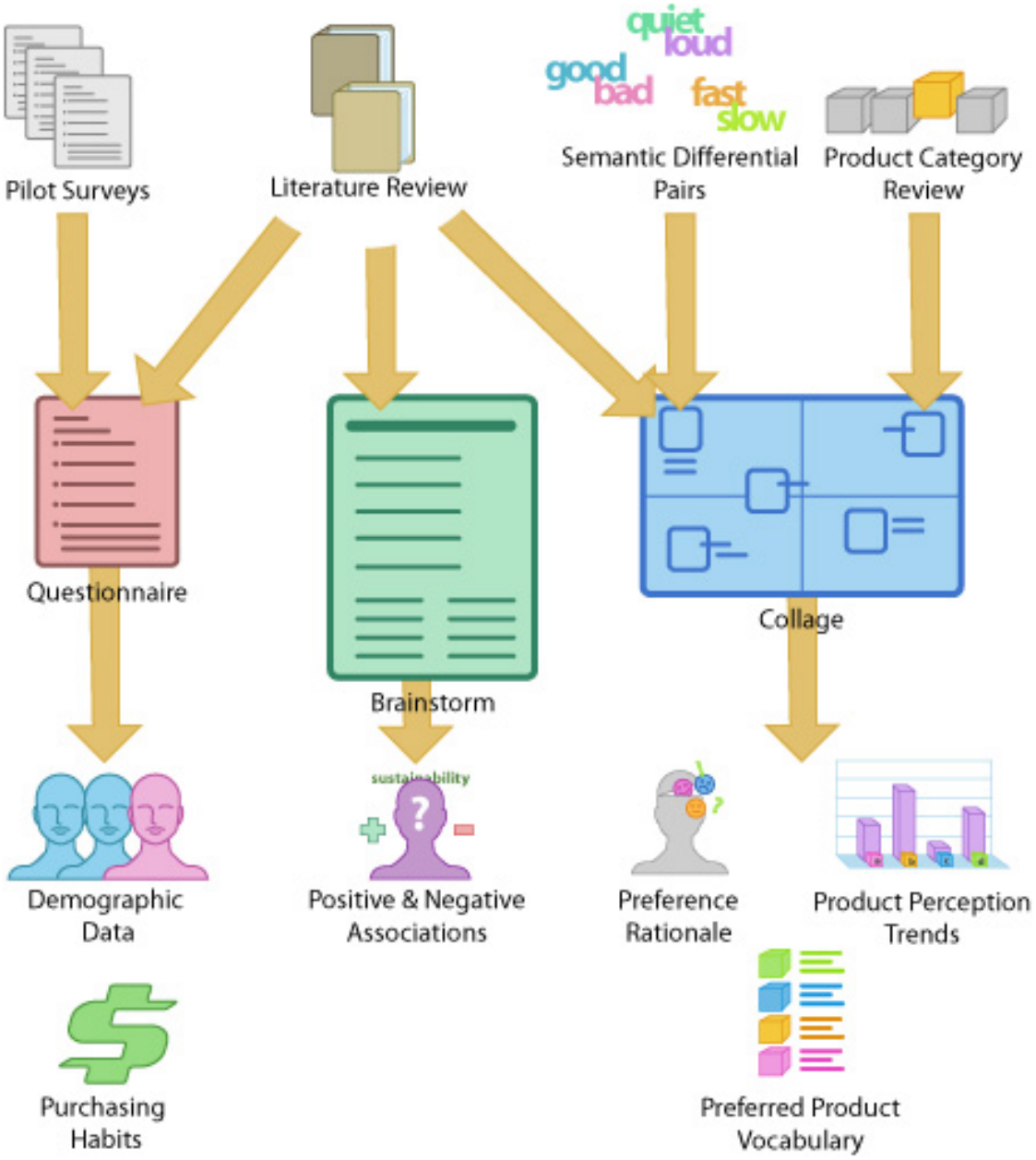


Figure 6. Research Instrument Composition and Results.

3.2.1 – Questionnaire

The first activity presented in the research session was a short questionnaire (see Figure 7). The questions were compiled after analyzing available literature, as well as two pilot surveys that were conducted prior to this study. The literature review and studies conducted by other researchers provided a basis for questions, and the information taken from the two pilot surveys aided in refining the area of inquiry and the phrasing of the questions. This traditional research tool served as a standardization method for the rest of the research instrument. It provided a way to gather useful demographic data that is easily captured in the survey format, as well as information not otherwise captured in the study. The two prior pilot studies, while not appropriate for the scope of this particular exercise, provided a basis for condensing the subject matter for this questionnaire as well as reference material to compare the results against later.

The four question survey was constructed to gather basic demographic data about the participants; namely, their age and gender. Other information included how receptive they were to buying sustainable products and whether they would be willing to pay a premium for sustainable products. Preliminary research from available literature and my own investigation suggested that the majority of the survey population were not familiar with the term ‘sustainable’ or sustainability. Therefore, the Agenda 21 definition of sustainability was provided on the questionnaire. While very brief, the questionnaire captured key data and served to summarize the main objectives of the pilot surveys, namely determining consumer’s attitudes towards sustainable purchasing and their education levels concerning sustainability.

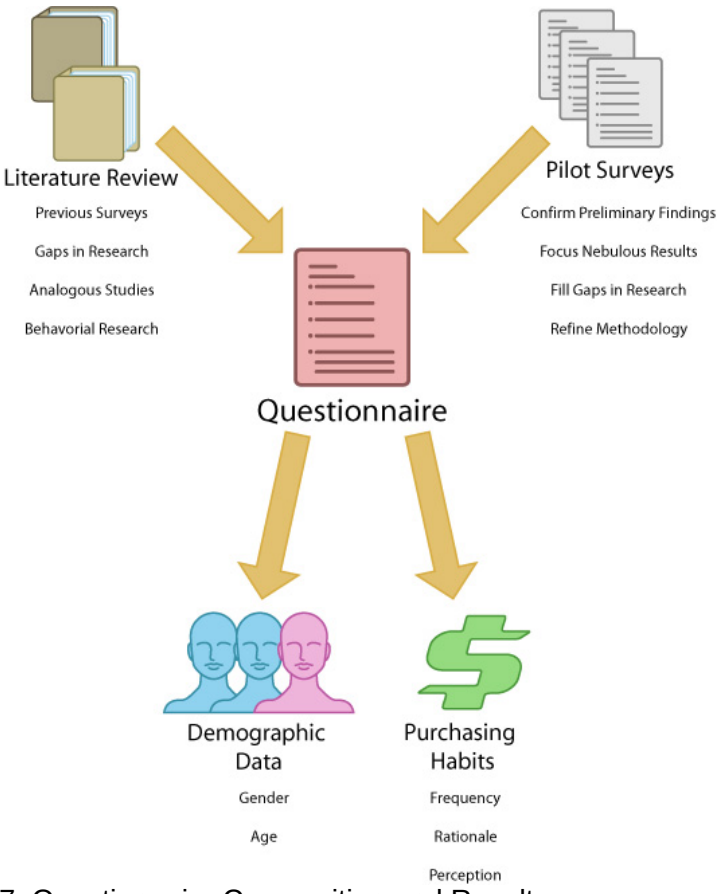


Figure 7. Questionnaire Composition and Results.

All of the questions were closed format except one, which was an open ended question asking participants why they bought sustainable products, if at all. This question served to determine the salience of previous questions, as per methods described by Sommer and Sommer (2002). Also, it served to give insight about the participant's level of education concerning sustainability. Studies performed by Laurie Demeritt suggest that individuals asked to describe their motivations for sustainable purchases often use specific vocabulary based on their level of understanding (2005). The questions were also worded according to Sommer and Sommer's guidelines in an attempt to minimize bias, and were reviewed by a professional marketing surveyor as independent verification.

The questionnaire was evaluated via traditional methods. The results from each closed format question were tabulated and broken down by gender. The results would have also been broken down by age groups if the age variance had been larger. The open format question was evaluated by dividing and cataloguing similar responses. Each questionnaire was marked with the subject's identification code and compared to the subject's later remarks from the collage exercise. The main information derived from this exercise includes the subjects' demographic data as well as some insight into the subjects' purchasing habits, which is not covered elsewhere in the exercise.

3.2.2 –Brainstorming Exercise

After completing the questionnaire, subjects were asked to participate in a brainstorming exercise (see Figure 8). The brainstorm about sustainable terminology prompted participants to explain sustainability in their own words. This exercise served the two-fold purpose of prompting participants to think critically about sustainability before they worked on the collage exercises, and providing a secondary method for understanding their education levels and perceptions about sustainability. Subjects were first asked to identify general terms they might use to describe sustainability or sustainable products, and then were asked to identify positive and negative terms they might associate with sustainability and sustainable products.

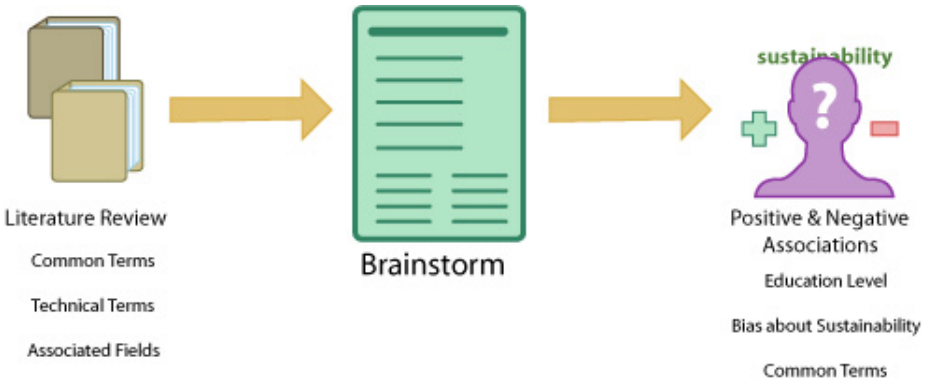


Figure 8. Brainstorm Composition and Results.

The brainstorm exercise was evaluated by tabulating the frequency of terms subjects mentioned, as well as cataloguing the terms into basic categories. This part of the research exercise yielded insight into the subjects' positive and negative associations with sustainability and sustainable products, as well as a basic understanding of their education levels and awareness of the topic. The terms from this part of the exercise could be used to refine the vocabulary set used in future iterations of the research exercise, although such an application was not used here.

3.2.3 – Collage Exercise

The final exercise that subjects were asked to complete was a set of three collages (see Figure 9). The collage exercises each consisted of an image set containing twelve images of similar products from a specific category, a vocabulary set of 80 descriptive terms, and a large four quadrant grid marked with the terms 'Sustainable,', 'Unsustainable', 'Like', and 'Dislike' (see Figure 10).

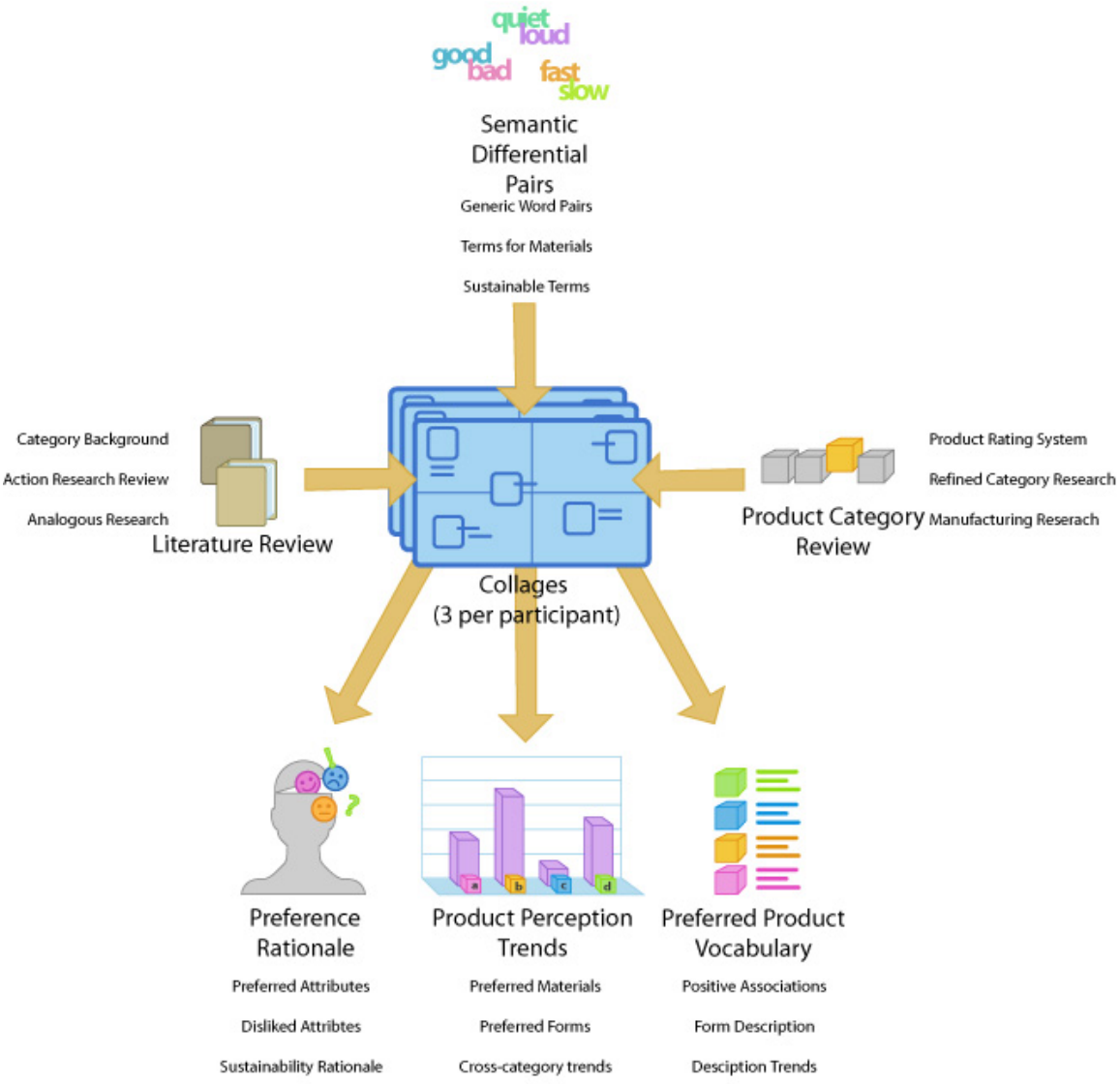


Figure 9. Collage Composition and Results.

Figure 10. Blank collage diagram.

Subjects were given three different product sets to evaluate; the image sets were distributed among the various packets so that no two subjects would evaluate the same images at the same time. This distribution, as well as providing multiple sets of products to the subjects allowed for better evaluation of the results for both consistency and validity. The same vocabulary set was provided for all image sets, and was given to the subjects in the form of sticker sheets. The subjects completed the collage exercise by placing images on the sheet in locations that expressed their like or dislike of the product, as well as their perception of the product's sustainability. Then, the subjects were asked to take vocabulary from the sheets and place them with the products that were best described by the term. Subjects were encouraged to use words more than once, as well as use their own terms if they couldn't find appropriate vocabulary to describe an image. After the image and vocabulary placement was completed, the subjects were asked to explain their overall rationale as well as detail their specific choices for most and least sustainable products. The subjects' responses were recorded via videotape and notes. While essentially freeform during execution, the materials

provided were carefully researched and constructed in an effort to provide a non-traditional research activity that was reproducible and maintained a high level of validity.

The construction of the participatory research activity began with an investigation into past studies with similar research goals or hypothesis. Since the main focus of the study was insight into the product semantics associated with sustainable products the investigation began with product semantics studies. Krippendorff and Butter indicate the need for empirical research, and their discussion and methods provide the basic structure for product semantics research (1984). Many studies in product semantics use focus groups to gather data. Focus groups allow researchers to investigate subjects' attitudes, feelings, beliefs, experiences and reactions in a way in which would not be feasible using other methods (Gibbs, 1997).

Although it does not provide much information about how to conduct a semantic study, the methodology detailed by Veryzer (1997) focuses on a quantitative way to evaluate the consumer's reaction to product semantics. Given the nature of Veryzer's research, this study was constructed with the end goal of evaluation via Veryzer's methods, specifically using terms that could be classified as AEs and PPCs. The formula Veryzer uses to evaluate the relationship between attribute expedients and perceived product characteristics is provided in Figure 11. This method can be used iteratively through a design process for a single product in development to compare it with competitors. In the case of this study, it can be used to determine which elements of various designs communicate most effectively to the subjects involved.

$$S = [(I_P /C) + (I_P/ I_P)]/2$$

S = Sentientality index for a particular element or constellation of elements

I_P = The number of times a particular interpretation is mentioned

C = The total number of consumers tested

I_T = The total number of interpretations for an element or constellation

Figure 11. Formula for Veryzer's Sentientality Index

Key Selection Motivators
1. Product must be easy to identify
2. Product must be made of a wide range of materials
3. Product must have a general, identifiable function
4. The products should not be entirely energy-focused

Figure 12. Key Selection Motivators for Product Categories

The product selection process was a key step in this research method. There were four key product selection motivators, which are outlined in Figure 12. First, the product had to be easy for consumers to identify. The products needed to be familiar enough to the user that they would be able to immediately identify the basic product and attach it to its semantic background. This criterion works well with products that have existed in a familiar incarnation for a long period of time, such as furniture. This criterion excludes products that are very technology-intensive, as well as products that have a form that doesn't convey their function, such as portable music players. The second criterion was that the products had to be manifested in a wide range of materials, from sustainable to unsustainable. This criterion allows for investigation into the consumer's attitudes about

various materials and how the consumer feels about how those materials affect their perception of the product. Some items that fit this criterion include footwear and furniture. Products that don't fit well into this criterion include products that are made of specific materials designed to meet a functional criteria. For instance, a product containing semiconductor electronics adds an environmental impact to a product which is difficult to gauge and is often invisible to the user, adding environmental impact without expressing it semantically. The third criterion, much like the first, requires that the product's function remain general. The more specialized the product's function becomes, the narrower the user base, product form, and materials. Much like confusion introduced by a vague or incomprehensible form, the object's function needed to be easily recognizable so the user could make judgments about the product quickly. Objects that have simple interfaces, like a cup or mug, are exemplar of this criterion, while products with complex or layered interfaces such as automobiles or personal computers are not. The final criterion specifies that the researched products are not energy-focused. One of the challenges of sustainable product evaluation lies in the difficulty of separating out the consumer's reaction to the sustainable intent of the product, or the economic incentive that often comes along with energy efficient products. An example of this issue exists in the hybrid vehicle market; while these vehicles are often marketed as environmentally friendly products, another key element of their appeal to consumers is the economic benefit that is a result of their efficient use of gasoline (Berman, 2006). By omitting energy-focused products from this product semantics study, the user's focus will be more centered on the materials, forms, and the visceral emotional response the product evokes. Table 1 shows the consumer product categories that were considered. A rating of '5' indicates that the category had many

strong examples of that criterion, while a score of '1' indicated that the category had very few appropriate examples.

Table 1. Product Category Evaluation and Ratings

Product Category	Identifiable	Form	Materials	Generality	Energy focus?	TOTAL
Seating	**5**	**5**	**5**	**5**	**5**	**25**
Mugs	**5**	**4**	**4**	**5**	**5**	**23**
Shoes	**5**	**4**	**4**	**4**	**5**	**22**
Lamps	**4**	**5**	**4**	**4**	**4**	**21**
Kitchen Utensils	**4**	**4**	**4**	**4**	**5**	**21**
Watches	5	3	3	5	4	20
Tables	5	2	3	5	5	20
Clothing	4	5	3	3	5	20
Automobiles	5	5	3	5	2	20
Beds	5	2	3	4	5	19
Remotes	4	3	2	2	4	15
Appliances	4	3	1	3	1	12
Cell phones	3	2	2	1	3	11

After these categories were finalized, image libraries were combined for each one. A key observation that arose in the image compilation process was that while some products fit the initial criteria very well, the initial category definition was too broad. For instance, the seating category scored very high within the decision matrix, but seating encompasses everything from thrones to floor pillows, both of which are very different in form and function and provide little significance in their comparison. All of the basic categories required a stricter definition to provide a set of products that could be equitably compared, but still have enough variety for a range of semantic cues. For instance, choosing men's ankle-length boots as a subset within shoes provided a product set small enough to allow subjects to make comparisons within the set, but did not limit the

choices so much as to be trivial (whereas choosing the shoe subset of rock-climbing shoes severely limited the form, materials, and function of products within that subset). Similar choices were made for the four other product sets, and the final product categories appear in Table 2 with their ratings.

Table 2. Refined Category Evaluation and Ratings.

Refined Category	Identifiable	Form	Materials	Generality	Energy Focus?	TOTAL
Non-task, non-folding, non-stackable seating	5	4	5	5	5	**24**
Hot beverage cups	5	4	4	5	5	**23**
Men's ankle-height shoes	5	4	4	4	5	**22**
Non-task lighting	4	5	4	4	4	**21**
Cooking Spatulas	4	4	4	4	5	**21**

After choosing each category, the next step in the process was to outline a set of vocabulary for evaluation and to choose individual products within the cluster to represent an array of choices. These steps actually occurred in tandem; the vocabulary set was constructed to describe a wide range of product attributes and at the same time use that vocabulary set to evaluate the product clusters for variety. Many of these words were taken from common semantic pairs, as well as common material types that appeared throughout the product categories. With these words as a starting point, semantics research was used to construct semantic differential pairs, which are opposing descriptive terms for a specific characteristic. Semantic differential pairs are typically used in a questionnaire or survey instrument; for the purposes of this instrument they were used to develop a balanced vocabulary set that can be used to describe a

wide variety of products. Semantic differential pairs come in three basic types: *Evaluative*, *Potency*, and *Activity* (Osgood, Suci, and Tannebaum 1957). Evaluative terms, such as good-bad, worthless-valuable, and dirty-clean indicate a value judgment. Potency pairs, such as strong-weak and hard-soft relate to the intensity or efficacy of the item being considered. And finally, Activity pairs such as *fast-slow* and *quiet-noisy* are used to describe activity level. When semantic differential pairs are used in survey instruments it is important to have a variety of pair types from the three categories, so several pairs from all three categories were included. The vocabulary list was also evaluated with respect to Veryzer's terminology; Veryzer's methods were included to understand the attributes behind the subject's perceptions regarding the evaluated products. To accomplish this goal, terms were included that participants would identify as attribute expedients and perceived product characteristics. For attribute expedients vocabulary, included terms described the form, material, and texture of the product, such as *angular*, *metal*, and *rough*. Terms were also included to represent perceived product characteristics such as strong, elegant, and playful. Once the vocabulary list was completed, key differential pairs (Figure 13) were used to choose product subsets within the overall product categories that covered those semantic descriptors. These pairs were considered key vocabulary because they were clear representations of the traits they described, and provided a core set of descriptors that could be used to rate across every product set in the research exercise.

Semantic Pair	Semantic Descriptor Type (P = Potency, E = Evaluative)	Veryzer Descriptor Type (PPC = perceived product attribute, AE = attribute expedient
Aggressive Submissive	P	PPC
Expensive Inexpensive	E	PPC
Simple Complex	P	AE
Raw Refined	E	PPC
Durable Fragile	P	PPC
Organic Synthetic	E	PPC
Beautiful Ugly	E	PPC
High quality Low quality	P	PPC
Hard to use Easy to use	P	AE
Masculine Feminine	E	PPC
Mechanical Natural	E	PPC

Figure 13. Key Semantic Pairs with Descriptors and Veryzer Classification.

Besides these main criteria, the product subsets were narrowed by removing products that only met one or two of the semantic pair descriptors and by removing products that were very similar in form, materials, or function (i.e., two pairs of hiking boots). There was a sustainable choice included in every product category so subjects' reactions to those products could be recorded. After evaluating the product categories based on these criteria, the image sets were narrowed down to twelve products for each category. This number allowed for variation within the product images while not being so varied that the subject was confused by too many choices. Once the key choices of image sets and vocabulary were made, the collage exercise was essentially complete. A short script

was composed which was used in conjunction with the collage exercise to make sure that information was collected from each subject about a few key items, mainly getting them to describe the extreme positive and negative ends of their scale, to better understand their choices and overall rationale.

The collage sets were the most complex part of the research instrument evaluation process. Each subject completed three collages, which were labeled with the subject's identification number as well as their order of completion. The collage results were measured from the completed collage posters, and placed into various charts. Each category was charted per individual subject response as it appeared on the original collage, as well as collected results for each product. The charts which included all subject responses for an individual product also included the average of all subject ratings for that item. The category averages were also plotted in a chart by themselves, along with the average of the averages. The scores for each product were ranked by each axis, as well as the sum of the normalized scores from both axes; normalization eliminated the bias between the preference and sustainability axes. The normalized sum was used to determine the top products for each category, both in preference and sustainability. The collage vocabulary was evaluated for frequency of use, both general use and use with the top rated products. The video records of the subjects' explanation of their choices for vocabulary and product placement were also reviewed to determine basic motivations in the subjects' rationale. The main findings from this part of the research exercise included trends in product perception, trends in positive product descriptions, and preference rationale both within product categories and across categories as well.

CHAPTER 4: RESULTS

4.1 - QUESTIONNAIRE RESULTS

The study was conducted with sixteen subjects, and the initial questions posed to the subjects were about age and gender. The average age of subjects was 23.8, the youngest subject being 20 and the oldest being 34. Overall, the sample population was relatively young given that the average age in the developed world is 37.4 years (United Nations, 2001). The research population was 68.75% male, and 31.25% female, which is divergent from the average of approximately 50% each.

Table 3. Closed Format Questions from Questionnaire with Results.

Question	Overall
1. How important is sustainability to you?	Very important: 12.5%
	Somewhat important: 87.5%
	Not very important: 0.0%
	Not at all important: 0.0%
2. Do you purchase sustainable products?	Yes: 81.25%
	No: 18.75%
4. How much are you willing to pay for sustainable products?	Significant premium: 0.0%
	Slight premium: 56.25%
	Competitive pricing: 43.75%
	Only if cheaper: 0.0%
	Never purchase: 0.0%

Table 3 catalogues the questions posed in the survey. Question 1 only garnered two types of responses, although four choices were provided. All subjects indicated that sustainability was important to them, the majority indicating it to be somewhat important.

A larger proportion of females indicated that sustainability was very important to them (20%) opposed to males (9.1%), although it may be noted that only one respondent from each gender indicated that sustainability was 'very important'. A majority of respondents indicated that they purchased sustainable products, and for this question the genders were almost evenly matched in their responses; 80% of females indicated that they bought sustainable products while 81.8% of males indicated the same. When asked what premium they would be willing to pay for sustainable items, however, the genders were fairly divided in their responses. Less than half (45.4%) of males were willing to pay a premium for sustainable goods, while 80% of the females surveyed were willing to pay a slight premium. No one indicated they would be willing to pay a significant premium, or indicated that they wouldn't be willing to purchase sustainable goods at all. This information corresponds to the findings presented by Vermeir and Verbeke, who found that consumers were willing to pay a slight premium defined as 5% to 25% above conventional prices, in a marketplace where premiums often ranged from 40% to 175% (2004).

The third numbered question was open-ended, asking subjects why they did or did not buy sustainable products. The responses fell into a few distinct categories; neutral and positive responses, as well as several more categories under the positive response category (see Appendix B). 62.5% of the subjects gave positive responses, 25% of the subjects gave neutral responses, and 12.5% of the subjects did not answer the question or did not provide an intelligible answer. Responses were considered neutral if the subject indicated that they only bought sustainable goods when another criteria such as price or preference was met, or indicated that they did not use the sustainability of the product as a selection criteria for products in general. In every case, neutral subjects

mentioned cost as the overriding criteria of their purchasing habits, and indicated that they would only purchase sustainable goods if they were competitively priced with other products. All of the neutral respondents' answers corresponded with their answers to Question 4, where they also indicated that they would only purchase sustainable goods at a competitive price. The positive response category had a more varied set of answers; the positive responses could be divided up into two main categories, future-centered and present-centered. Future-centered responses indicated that they would buy sustainable goods in the hope of making the world a better place for future generations. Most (57%) present-centered responses were focused on the individual's sense of personal responsibility for the environment, and a smaller contingent (28.5%) indicated that they bought sustainable products in an effort to support the wider production of sustainable products by business interests. The positive respondents, however, did not unanimously indicate they would pay a premium for sustainable products; 70% indicated that they would pay a slight premium, while 30% indicated that they would only purchase sustainable products at prices competitive with other products.

4.2 - BRAINSTORM RESULTS

During the ten minute brainstorming session, subjects were asked to identify general, positive, and negative terms they associated with sustainability, given the definition that had been provided. The terms were recorded on a poster by category, and the poster remained on display through the rest of the session. The subjects identified 81 unique terms over the course of six sessions; the first and last sessions did not participate in the brainstorm method (see Appendix B). The terms that appeared more than once are listed in the table below.

Table 4. Frequently Mentioned Terminology from Brainstorm Exercise.

Term	Times Mentioned
expensive	6
green	5
recyclable	4
hippies	3
biodegradable	2
reuse	2
ugly	2
healthy	2
renewable	2

The entire list of terms can be divided into several categories, which are listed in Figure 14 below with some example terms from each.

Category	Examples
Product Durability	Long-lasting, robust, looks like it will crumble
Energy Use	Efficient, low energy use, cheaper energy
Post-Consumer Handling	Recyclable, cradle to cradle, biodegradable
Perception of Consumers	Hippies, tricked, progressive, smarter
Cost of Sustainable Products	Expensive, profitable
Product Aesthetics and Function	Ugly, healthy, low-impact, future-oriented

Figure 14. Brainstorm Terminology Categories and Example Terms.

Product durability refers to the subjects' perception of the durability of sustainable products. 60% of those who mention durability had a positive perception of sustainable product durability, indicating that they believe sustainable products are long-lasting. The remaining 40% have a negative perception, mentioning terms like 'poor longevity'. The

category of Energy Use includes any terms specifically referencing energy use. All subjects that mentioned terms involving energy use had a positive perception of sustainable products, in that they used less energy than their counterparts. *Post-Consumer Handling* is a category of terms focused on how the products are dealt with after use. Many of these terms did not appear in positive or negative categories, but represented general terms that subjects associated with sustainability. These terms included examples such as 'biodegradable' and 'cradle to cradle'. Although they did not see sustainability itself as an act with negative connotations, the subjects' perception of sustainable consumers was generally negative. Most of the terms mentioned referred to the consumer's insufficient education about sustainable products, with words such as 'ignorance 'and 'greenwash'. Terms that might be associated with sustainable consumers were generally negative as well, 'backwards' and 'hippies' being mentioned. One positive term, 'progressive', was mentioned in reference to the sustainable consumer. The fifth category, Cost of Sustainable Products, was primarily negative as well. As presented in Table 4, the term 'expensive' was mentioned the most frequently of all terms. And finally, the Product Aesthetics and Function category represents terms that are related to subjects' perception about their interaction with sustainable products. The terms in this category did not follow a strictly positive or negative trend. Positive terms, such as 'healthy' and 'resource friendly' as well as negative terms such as 'ugly' and 'hard to find' appeared in almost equal numbers.

4.3 – COLLAGE RESULTS BY CATEGORY

The collage exercises produced a wide array of information. The main categories of information include general placement trends, rationale for placement, and the vocabulary used to describe each category and each specific product. General placement trends include general trends in how the product category was mapped in general, how specific products in that category were mapped, as well as specific attention to products that received the highest and lowest ratings**.** The rationale for placement is the subject's own description of their general rules for item placement, as well as their description of the highest and lowest ranked products. The vocabulary category includes an evaluation of terms most frequently used for each category and product, as well as a breakdown of frequently used terms for the highest and lowest rated products. These various categories of information provide a larger picture of the subjects' thoughts on product aesthetics and perceptions about the products' sustainability.

The collage data was evaluated for product placement, use of vocabulary, and subject statements based on the finished collage. The values for the two product rating axes, preference and sustainability, was determined by the physical location of product images; these measurements were taken from the center point of the images, and were measured in inches on the page. The measurements were taken from the bottom left corner of the collage sheet, with zero being the minimum score on both axes and 18 being the highest score for preference and 24 being the highest score for sustainability. Products were evaluated on their raw score along the sustainability axis, the preference axis, as well as the total they received when the scores from both axes were tallied and

how many times they were placed in the top right quadrant of the page, indicating subjects liked the product and thought it was sustainable. The scores for each axis were normalized in the evaluation of the total scores for each category so that equal weight would be given to each axis. Vocabulary was tallied for each product by counting the number of times a specific word was associated with that product, either by being pasted directly on or adjacent to the product image or another clear indication of association such as a line drawn from the word to the image. The number of terms used for each product was also tallied, with specific attention paid to the terms used in the top five products for each category. The terms used for the top five for each category were evaluated for trends, determined by the use of a term three or more times for different products in the top five rated products.

4.3.1 - Spatulas

The spatula category was the first product category that was evaluated. This category provided good examples of simple products that were relatively easy to understand and identify. There were two main subcategories within the general category of spatulas. One spatula type was used for mixing and spreading actions, while the other type was used during hot cooking processes to transfer and flip food; the spatula category here only includes the latter. Product images used in this study include a range of materials and forms, from single material products made of wood or metal to multiple material products that include synthetic compounds and complex forms. All products in the category are identified in Figure 15.

Figure 15. Spatulas used in the Research Instrument

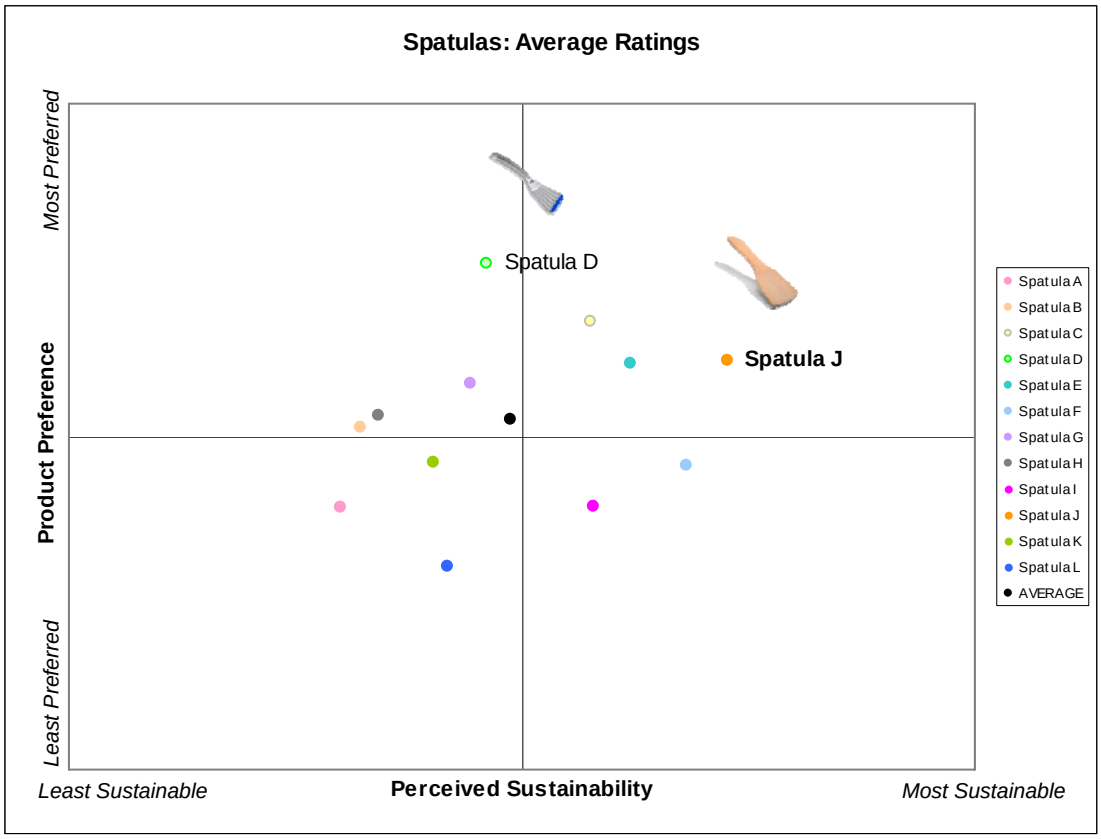


Figure 16. Average Ratings for All Spatulas

The average placement of all products in the spatula product category is shown in Figure 16, above. This category had a placement pattern that centered around the neutral origin point. Spatula D, pictured above, was the product subjects liked the best out of this category on average. Spatula J, also pictured above, was the product subjects believed to be the most sustainable choice. Spatula J was also the product that received the highest normalized score for this category. Table 5 below catalogues the five products that appeared most in the upper right quadrant, indicating that they had a positive rating in both perceived sustainability and subject preference. Table 6 ranks the products in this category according to their standard deviation above the mean score, and includes all products that scored above the category average.

Table 5. Top Five Spatulas based on Frequency of Appearance in the Upper Right Quadrant.

Spatula		Frequency
C		5
J		4
D		3
E		3
I		3

Table 6. Products with Above Average Total Scores in the Spatula Category.

Spatula		Frequency
J		2.34
C		1.74
D		1.62
E		1.56
F		0.82
G		0.09

Subjects had a few main ideas that directed their choices for this product category. For instance, four out of the nine participants asked to survey this product category considered metal products to be the most sustainable choices. They cited the durability of the product as the main factor determining sustainability for this category, and also voiced their belief that metals were easily recyclable as well. While Spatula J received the highest score on the sustainability axis, subjects were concerned that it would not last as long as its metal counterparts. Over half of the subjects stated that complex products with multiple parts and materials would be harder to recycle or disassemble, therefore making them a less sustainable choice than simpler, single-material products. As for personal preference of products, four of the nine subjects mentioned the ergonomics or perceived comfort using the product as the main reason why they liked the product.

The vocabulary used to describe this category set consisted of 67 unique terms, with the most popular listed in Table 7 below.

Table 7. Most Popular Terms used to describe Products in the Spatula Category.

Term	Frequency
Recyclable	16
Metal	13
Modern	12
Synthetic	12
Plastic	11
Simple	11

These terms correspond well to descriptions of the top five product choices; the majority of vocabulary choices are attribute expedients, however, *simple* and *modern* are terms

that can be classified as perceived product characteristics. The specific vocabulary terms used to describe the top five product choices appear in Table X below.

Table 8. Vocabulary Used for the Top Five Products in the Spatula Category.

C		J		D		E		I	
Modern	5	Wood	8	Durable	4	Metal	3	Complex	6
Glossy	4	Natural	7	Professional	3	Modern	3	Fragile	3
Metal	4	Organic	6	Expensive	2	Geometric	2	Mechanical	3
Professional	3	Pure	4	High Quality	2	Sleek	2	Hard to Use	2
Simple	3	Old	3	Metal	2	Active	1	Amorphous	1
Sleek	3	Simple	3	Modern	2	Beautiful	1	Dull	1
Solid	3	Handmade	2	Rigid	2	Dull	1	Efficient	1
Beautiful	2	Minimalist	2	Active	1	Expensive	1	Expensive	1
Durable	2	Raw	2	Disassemble	1	Feminine	1	Low Quality	1
Efficient	2	Recyclable	2	Easy to Use	1	Healthy	1	Metal	1
Elegant	2	Boring	1	Elegant	1	High Quality	1	Modern	1
Expensive	2	Calm	1	Flexible	1	Masculine	1	Recyclable	1
Clean	1	Dull	1	Healthy	1	Minimalist	1	Uncomfortable	1
Feminine	1	Feminine	1	Masculine	1	Organic	1	Unique	1
Functional	1	Light	1	Recyclable	1	Recyclable	1		
Heavy	1	Masculine	1	Refined	1	Refined	1		
Refined	1	Outdated	1	Sensible	1	Rugged	1		
		Rugged	1	Simple	1	Sensible	1		
		Solid	1	Sleek	1				
				Unique	1				
Total	40	Total	48	Total	30	Total	24	Total	24

The terms that appeared most among the top five choices are listed in Table 9 below:

Table 9. Vocabulary that was Most Frequently used to describe Top Five Spatula Choices.

Term	# of products in the top five that were described with this term	Total # of times this term was used to describe the top five products
Expensive	4	6
Metal	4	10
Modern	4	11
Recyclable	4	5
Feminine	3	3
Refined	3	3
Simple	3	7
Sleek	3	6
Dull	3	3
Masculine	3	3

4.3.2 - Mugs

The mug category was the second product category that was evaluated in this research exercise. This category also included examples of simple products that were relatively easy to understand and identify, although a few notable exceptions were either atypically complex or made from unusual materials (see Figure 17). Products that met the classification for this category were vessels that could be used to hold warm, potable liquids. Product images in this category include a range of materials and forms, as well as some product examples that have specific cultural significance, such as Mug B and Mug D, shown below.

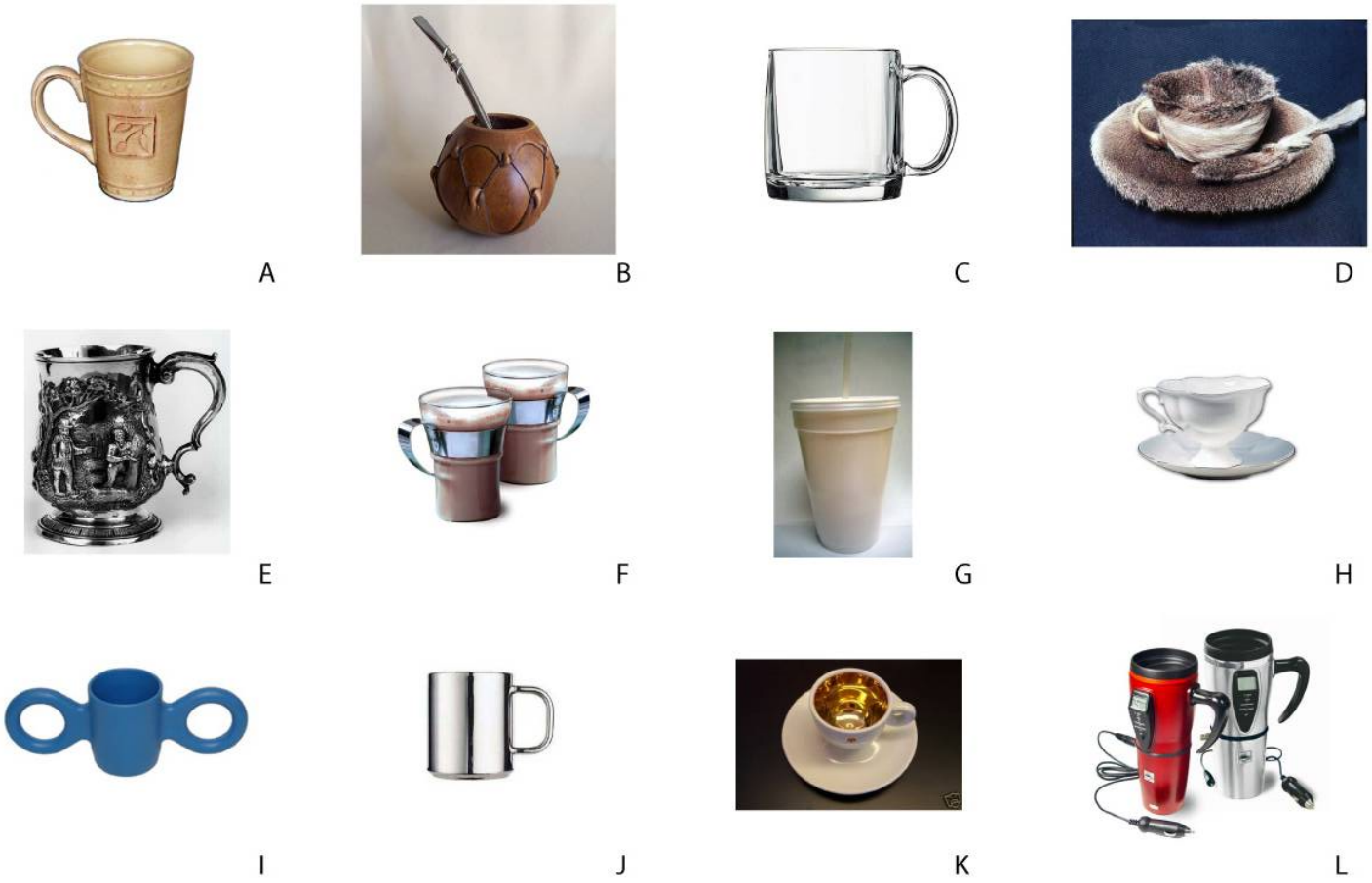


Figure 17. Mugs used in the Research Instrument.

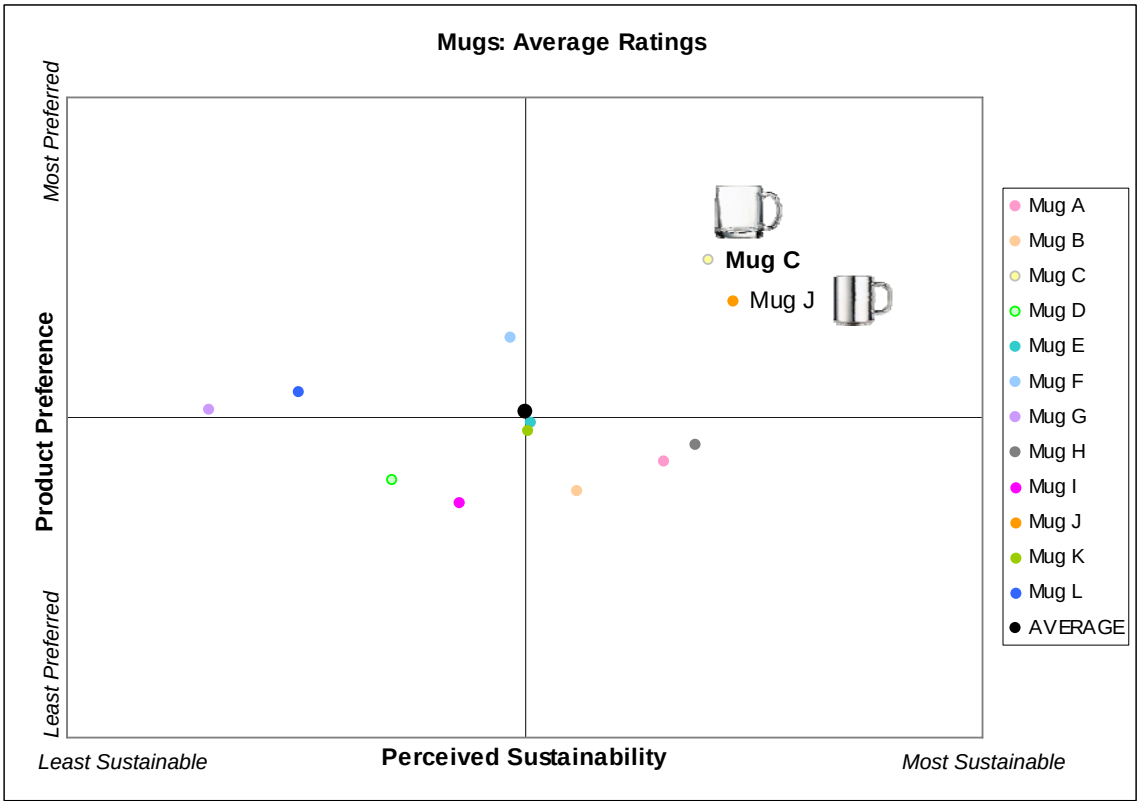


Figure 18. Average Ratings for All Mugs

The average ratings for Mugs were not as evenly distributed around the neutral axes as spatulas. While generally centered around the neutral axes, these products were more spread out along the horizontal axis, indicating that subjects believed the category had a relatively wide range of sustainable options, while the range of preference was less pronounced. Mug C, pictured above, was both the most preferred product choice and the highest scoring product on both axes. Mug J, also pictured above, was the highest scoring product on the sustainability scale. Table 10 below catalogues the five products that appeared most in the upper right quadrant, indicating that they had a positive rating in both perceived sustainability and subject preference.

Table 11 ranks the products in this category according to their total normalized score from both axes, and includes the products that scored above the category averages.

Table 10. Top Five Mugs based on Frequency of Appearance in the Upper Right Quadrant.

Spatula		Frequency
C		6
J		6
H		3
A		3
F		3

Table 11. Products with Above Average Total Scores in the Mug Category

Mug		Score
C		3.07
J		2.69
F		0.86
H		0.58
A		0.17

Mugs C and J lead the group with twice as many placements in the upper right quadrant as the next closest product, as well as the highest total normalized scores from both axes.

Most of the subjects who surveyed this category cited *simple* and *functional* products as the ones they liked the most of all in this product set. Metal and glass were considered to be the most sustainable materials in this category, with hard plastics and Styrofoam being the least sustainable. Many products in this category were also made from ceramics, which received a moderately positive rating. Most subjects did not address ceramics as a material, although those that did had conflicting views about its sustainability. Some believed that it was sustainable because it was made from natural materials; however, one subject noted that ceramics, being one of the few things left behind from ancient civilizations, does not break down on its own and therefore is not a sustainable material. Their rationale also included the product's quality as an heirloom object. Subjects believed that items like Mug H might be passed down through generations of a family, prolonging its lifespan and by that act making it a more sustainable option than other 'ordinary' products. Another, smaller segment of subjects thought that the artistic value of the product added to its perceived value, and therefore sustainability; this opinion was voiced for Mug B. Another interesting point to note is that while Mug G (a Styrofoam cup) was ranked last in this category in sustainability, some of the subjects professed a preference for it despite its negative environmental impact. They stated that they liked the cup for its simplicity and superior performance.

The vocabulary used to describe this category set consisted of 73 unique terms, with the most popular listed in Table 12 below.

Table 12. Popular Terms used to describe Products in the Mug Category.

Term	Frequency
Ornate	11
Decorative	9
Fragile	9
Old	9
Ugly	9
Unique	9
Metal	8
Simple	8

The majority of vocabulary choices were perceived product characteristics, as opposed to attribute expedients. This may indicate that subjects were unable to easily identify the constituent materials of the products. The specific vocabulary terms used to describe the top five product choices appear in Table 13 below.

Table 13. Vocabulary Used for the Top Five Products in the Mug Category.

C		J		H		A		F	
Minimalist	6	Metal	5	Fragile	6	Handmade	3	Outdated	2
Simple	4	Sleek	3	High Quality	3	Natural	3	Modern	2
Pure	4	Durable	3	Feminine	3	Organic	2	Elegant	2
Clean	3	Pure	3	Old	3	Imperfect	2	Efficient	2
Solid	2	Simple	3	Elegant	2	Ugly	2	Plastic	1
Fragile	2	Modern	2	Refined	2	Boring	2	Boring	1
Dull	1	Hard	2	Outdated	2	Dirty	1	Rigid	1
Easy to Use	1	Professional	2	Curved	2	Old	1	Sensible	1
Functional	1	High Quality	2	Bright	1	Unhealthy	1	Feminine	1
High Quality	1	Glossy	1	Heirloom	1	Low Quality	1	Sleek	1
Calm	1	Rugged	1	Light	1	Outdated	1	Professional	1
Sleek	1	Solid	1	Decorative	1	Easy to Use	1	Functional	1
Professional	1	Rigid	1	Ornate	1	Manmade	1	Unique	1
Modern	1	Minimalist	1			Solid	1	Comfortable	1
		Efficient	1			Rough	1	Simple	1
		Functional	1			Dull	1	Contrast	1
		Bright	1						
		Refined	1						
		Sensible	1						
	29		35		28		24		20

The vocabulary used to describe Mugs C and J were closely matched, with nine pairs of identical terms used to describe both of the products. This may be attributed to the fact that both Mugs C and J have essentially the same form, although they are made of different materials.

Table 14. Vocabulary that was Most Frequently used to describe Top Five Mug Choices.

Term	# of products in the top five that were described with this term	Total # of times this term was used to describe the top five products
Functional	3	3
High Quality	3	6
Modern	3	5
Professional	3	4
Simple	3	8
Sleek	3	5
Solid	3	4

4.3.3 - Boots

The boot category was the third product category that was evaluated in this research exercise. This category contained more complex products than previous categories (see Figure 19). While they were easy to identify as boots, the materials used for these products were often composite materials, and the joinery methods typically did not communicate the material properties or the construction of the product. Products that met the classification for this category were ankle height shoes for men. Product images in this category include a range of materials and forms, any many of the products were designed with a specific purpose in mind, such as the hiking boot (Boot I) or the orthopedic boot (Boot D).

Figure 19. Boots used in the Research Instrument.

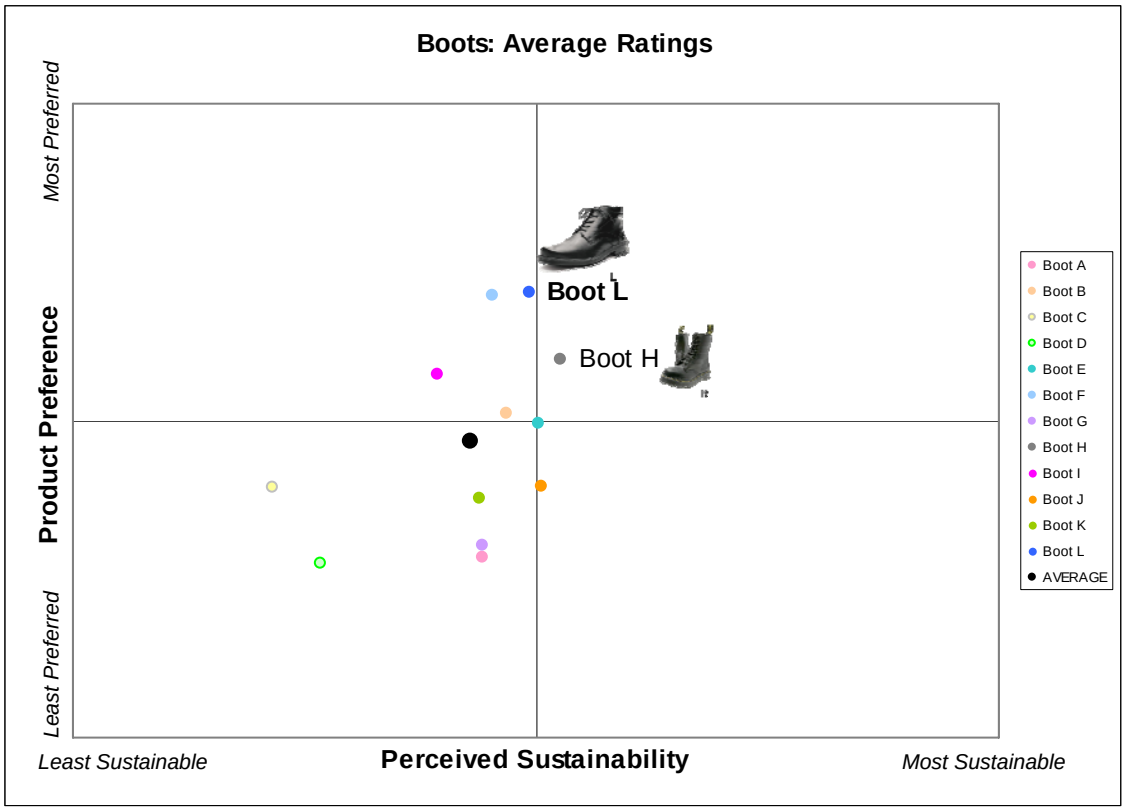


Figure 20. Average Ratings for All Boots

The average ratings for boots were not evenly distributed; this product category was still centered on the vertical axis, but was biased to the left on the horizontal axis. This shift indicates that the subjects have an overall negative perception of the category's sustainability. Boot L, pictured above, was both the most preferred product choice and the highest total scoring product, although on average subjects did not believe it to be particularly sustainable. Boot H, also pictured above, was the highest scoring product on the scale of sustainability. Table 15 below catalogues the number of times the top five products appeared in the upper right quadrant, indicating they had a positive rating in both perceived sustainability and subject preference. Table 16 shows

the products that scored above the category average, below. They are presented in order of their total score from both axes, with Boot L being the highest.

Table 15. Top Five Boots based on Frequency of Appearance in the Upper Right Quadrant.

Boot		Frequency
L		3
H		3
F		2
B		2
I		2

Table 16. Products with Above Average Total Scores in the Boot Category

Boot		Score
L		2.21
H		1.85
F		1.76
E		0.95
B		0.70
J		0.35
I		0.32

The number of times the product appeared in the upper right correlates with the total normalized score except in the case of Boot E, which had an almost neutral average placement (see Figure 21). Interestingly enough, Boot J, which was included in the category for its sustainable qualities, scored relatively low in both subject preference and perceived sustainability.

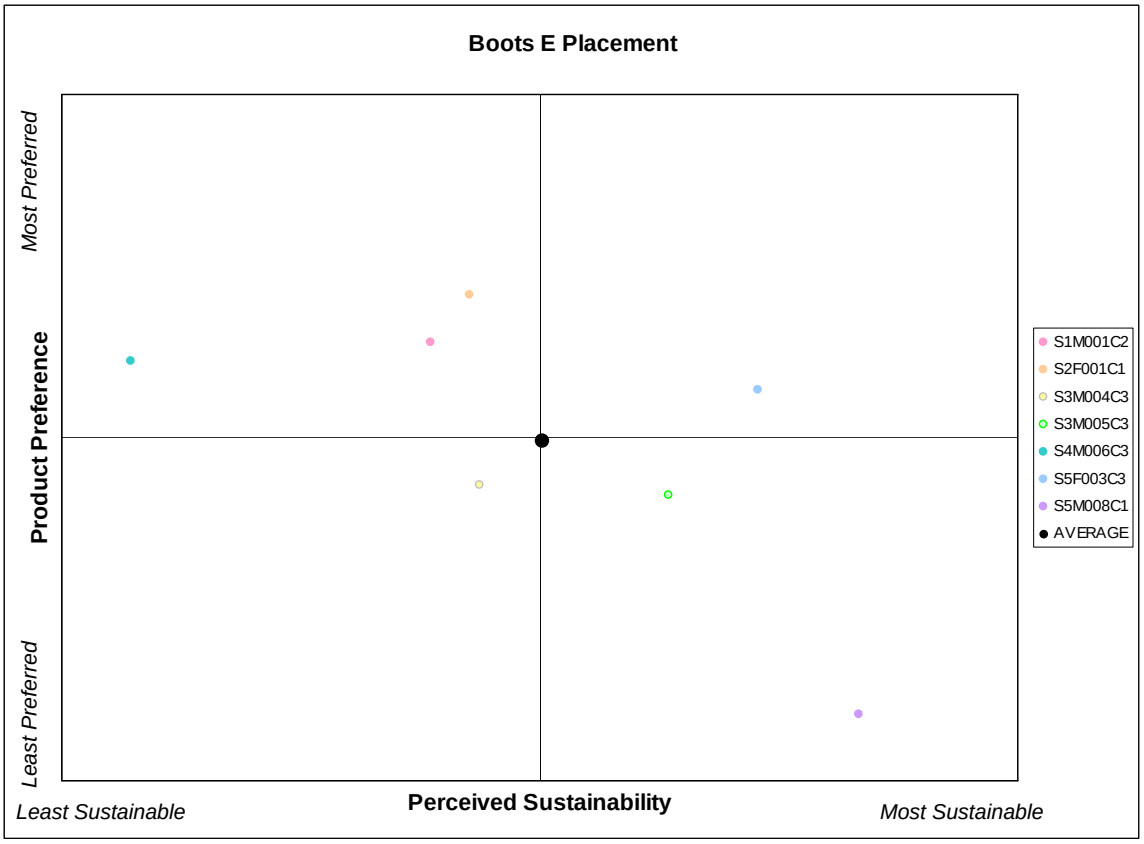


Figure 21. Individual Subject Ratings of Boot E, with Average.

This category was interesting in that many subjects volunteered the fact that they believed this was the least sustainable category in the group, which is reflected in the average ratings for products in this category. These subjects stated that shoes were inherently more unsustainable than the other products because the materials used in the product were either inseparably joined or unsustainable themselves. That being said, Boot J, a shoe which was marketed as a sustainable product, received mixed emotions from the group. Three of the nine subjects said they believed Boot J was sustainable because of how it looked and the way it was made. However, three other subjects recognized the brand of the shoe, and said they did not believe that the shoe was

sustainable at all. They believed that the ‘handmade’ look of the shoe was fabricated, and believed that the shoe was not really sustainable, based on their opinion of the product’s brand. Conversely, perceptions about brand were positive for another shoe; two subjects thought that Boot I was likely to be a sustainable product, based on the brand. They stated that since the company promoted an active, healthy lifestyle the company probably took steps to be environmentally conscious as well. They also associated the shoe’s brand with another brand, Patagonia, which one subject knew participated in sustainable activities. Subjects believed that Boot C was the least sustainable product in the category because it had several embedded parts, was made almost entirely from synthetic materials, and appeared to be a low quality product. Overall, subjects liked Boot L the best, stating that it appeared to be simple, comfortable, durable, high quality, and versatile.

The vocabulary used to describe this category set consisted of 65 unique terms, with the most popular listed in Table 17 below.

Table 17. Most Popular Terms used to describe Products in the Boot Category.

Term	Frequency
Rugged	17
Durable	15
Masculine	14
Functional	13
Ugly	12
Comfortable	10
High Quality	10
Organic	9

The majority of vocabulary choices are perceived product characteristics, as opposed to attribute expedients. This may indicate that subjects were unable to easily identify the constituent materials of the products, or that they felt the overall perception of the product was more important than the individual materials. The specific vocabulary terms used to describe the above average product choices appear in Table 19 below.

Table 18. Vocabulary Used for the Top Products in the Boot Category.

L		F		H		E		B		I		J	
High Quality	5	Bright	3	Durable	3	Rugged	5	Functional	5	Rugged	4	Organic	5
Expensive	5	Modern	2	Masculine	3	Masculine	4	Durable	4	Active	3	Recyclable	4
Elegant	4	Playful	2	Aggressive	3	Durable	3	Rugged	3	Synthetic	2	Ugly	2
Refined	3	Sensible	2	Rugged	2	Rough	2	Plastic	1	Comfortable	2	Handmade	2
Masculine	3	Active	2	Solid	2	Rigid	2	Heavy	1	Durable	2	Pure	2
Sleek	3	Comfortable	2	Heavy	2	Simple	1	Ugly	1	High Quality	2	Natural	2
Professional	2	Fun	2	Rigid	2	Functional	1	High Quality	1	Masculine	1	Flexible	1
Glossy	1	Flexible	2	Dirty	1	Solid	1	Minimalist	1	Functional	1	Comfortable	1
Functional	1	Unique	2	Ugly	1	Heavy	1	Fun	1	Solid	1	Manmade	1
Beautiful	1	Efficient	1	Functional	1	Professional	1	Playful	1	Aggressive	1	Soft	1
Simple	1	Easy to Use	1	Modern	1			Efficient	1	Healthy	1	Simple	1
Modern	1	Functional	1	High Quality	1			Manmade	1	Hard	1	Complex	1
Minimalist	1	Dull	1	Recyclable	1			Rough	1			Geometric	1
		Soft	1					Synthetic	1			Passive	1
		Low Quality	1					Masculine	1			Submissive	1
												Modern	1
												Raw	1
	31		25		23		21		24		21		28

Table 19. Vocabulary that was Most Frequently used to describe Top Five Boot Choices.

Term	# of products in the top five that were described with this term	Total # of times this term was used to describe the top five products
Functional	5	9
Masculine	4	11
High Quality	3	7
Modern	3	4
Durable	3	10
Heavy	3	4
Rugged	3	10

4.3.4 - Lamps

The lamp category was the fourth product category that was evaluated in this research exercise (see Figure 22). This category was comprised of products that were made of both simple and complex materials, some of which were easy to recognize and some which were not. The products also exhibited a wide variety of form language, from geometric to organic and from soft to hard surfaces. This category is also the only one in the research exercise that uses Products that met the classification for this category were lamps that would be used primarily for decorative lighting.

Figure 22. Lamps used in the Research Instrument

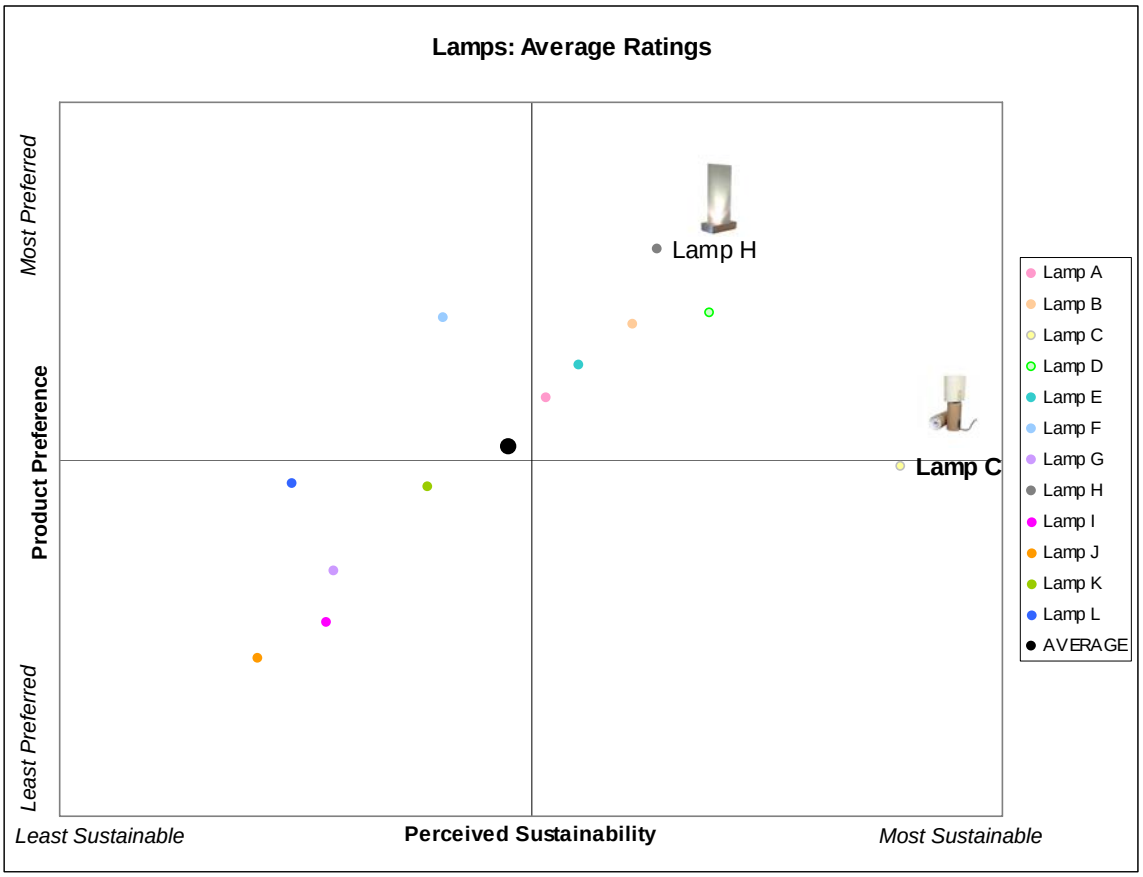


Figure 23. Average Ratings for All Lamps

The average ratings for lamps were not evenly distributed; this product category exhibited a possible correlation; products that subjects did not like tended to be rated lower on the sustainability scale, while products they liked received higher sustainability scores. Lamp H, pictured above, was the most preferred product choice. Lamp C, also pictured above, was the highest scoring product on the scale of sustainability as well as the highest scoring product on both axes. Interestingly enough, the average subject preference for Lamp C was relatively neutral; it garnered high scores for sustainability across the board, which raised it's overall score substantially. Table 20 below catalogues the number of times the top seven products appeared in the upper right quadrant,

indicating that they had a positive rating in both perceived sustainability and subject preference. Table 21 shows the products that scored above the category average, below.

Table 20. Top Five Lamps based on Frequency of Appearance in the Upper Right Quadrant.

Lamp		Frequency
H		5
D		5
C		3
B		3
E		2

Table 21. Products with Above Average Total Scores in the Lamp Category

Lamp		Score
H		2.32
D		2.07
C		1.85
B		1.60
E		1.00
A		0.57

The top scorers in this category corresponded to the number of times each lamp appeared in the upper right quadrant, which is reasonable given the strong diagonal trend for this category.

Lamp C was a product chosen for the category due to its sustainable attributes, but subjects had mixed feelings about it. Some participants appreciated its minimal aesthetic, and said they liked the fact that it was unique and relatively low in environmental impact. Others said that while it might be sustainable, they did not like it because it looked like pieces of trash and was a very low quality product. Lamp D and H received more positive feedback; subjects said they thought the lamps looked sustainable because of their simple aesthetic and natural-looking materials. Subjects also liked those products because they were ‘calming’, ‘modern’, and ‘inviting’, and mentioned they could also serve as sculptural pieces even if the lighting fixture ceased

to function. Other lamps received more negative feedback; five out of eight subjects said they believed that Lamp L contained toxic materials, even though two of those subjects said they still liked how it looked. Other lamps, such as Lamps I and J, received low ratings in both sustainability and preference because subjects believed they looked boring and old; many subjects associated ‘old’ with old materials and manufacturing processes, which they believed to be less sustainable than modern materials and processes.

The vocabulary used to describe this category set consisted of 69 unique terms, with the most popular listed in Table 22 below.

Table 22. Popular Terms used to describe Products in the Lamp Category.

Term	Frequency
Playful	9
Organic	9
Fun	9
Recyclable	8
Ornate	8
Modern	8
Elegant	8
Bright	8

The majority of vocabulary choices are perceived product characteristics, as opposed to attribute expedients. This may indicate that subjects were unable to easily identify the constituent materials of the products, or that they felt the overall perception of the product was more important than the individual materials. The specific vocabulary terms used to describe the above average product choices appear in Table 23 below.

Table 23. Vocabulary Used for the Top Products in the Lamp Category.

C		H		D		B		E		A	
Recyclable	8	Modern	3	Beautiful	3	Playful	5	Fun	5	Mechanical	4
Handmade	4	Elegant	2	Geometric	3	Plastic	4	Bright	4	Minimalist	4
Low Quality	3	Clean	2	Calm	2	Organic	3	Playful	3	Functional	2
Raw	3	Sleek	2	Solid	2	Juvenile	2	Unique	3	Flexible	2
Rugged	2	Beautiful	2	Modern	1	Durable	2	Soft	2	Sleek	2
Natural	2	Simple	2	Fun	1	Fun	2	Easy to Use	1	Complex	1
Inexpensive	2	Pure	2	Unique	1	Amorphous	2	Decorative	1	Expensive	1
Unique	1	Organic	2	Soft	1	Curved	1	Feminine	1	Metal	1
Sensible	1	Soft	1	Simple	1	Rounded	1	Clean	1	Durable	1
Organic	1	Professional	1	High Quality	1	High Quality	1	Aggressive	1	Masculine	1
Functional	1	Calm	1	Pure	1	Flexible	1	Ugly	1	Rigid	1
Minimalist	1	Comfortable	1	Natural	1	Unique	1	Juvenile	1	Refined	1
Elegant	1	Natural	1	Glossy	1	Active	1	Synthetic	1	Modern	1
Modern	1	Straight	1	Decorative	1	Busy	1	Modern	1	Unique	1
Efficient	1	Masculine	1	Feminine	1					Active	1
Manmade	1	Bright	1	Inexpensive	1					Efficient	1
		Geometric	1							Sensible	1
		Ornate	1							Professional	1
										Boring	1
	33		27		22		27		26		28

The terms that were used to describe Lamp C had several terms that can easily be related to its high sustainability score, such as *recyclable*, *handmade*, *natural*, and *organic*. Lamps H and D, which received similar average scores, had eight pairs of identical terms. While they do not look or function exactly the same, they appear to elicit similar reactions from the research subjects.

Table 24. Vocabulary that was Most Frequently used to describe Top Five Lamp Choices.

Term	# of products in the top five that were described with this term	Total # of times this term was used to describe the top five products
Modern	4	6
Unique	4	6
Natural	3	4
Organic	3	6
Soft	3	4
Fun	3	8

4.3.5 - Chairs

The final category that was evaluated in this research exercise was the chair category. This category contains products that are all consistently identifiable as chairs, although they are made in a wide variety of forms and materials (see Figure 24). Products that met the classification for this category were chairs that would not be used specifically as task seating for a typical work day (eight hours). Chairs as artifacts, while they maintain a utilitarian essence of providing a place to sit, also communicate a wide variety of aesthetic values to the user, which allows them to manifest a simple function in an almost endless array of forms and materials.

Figure 24. Chairs used in the Research Instrument.

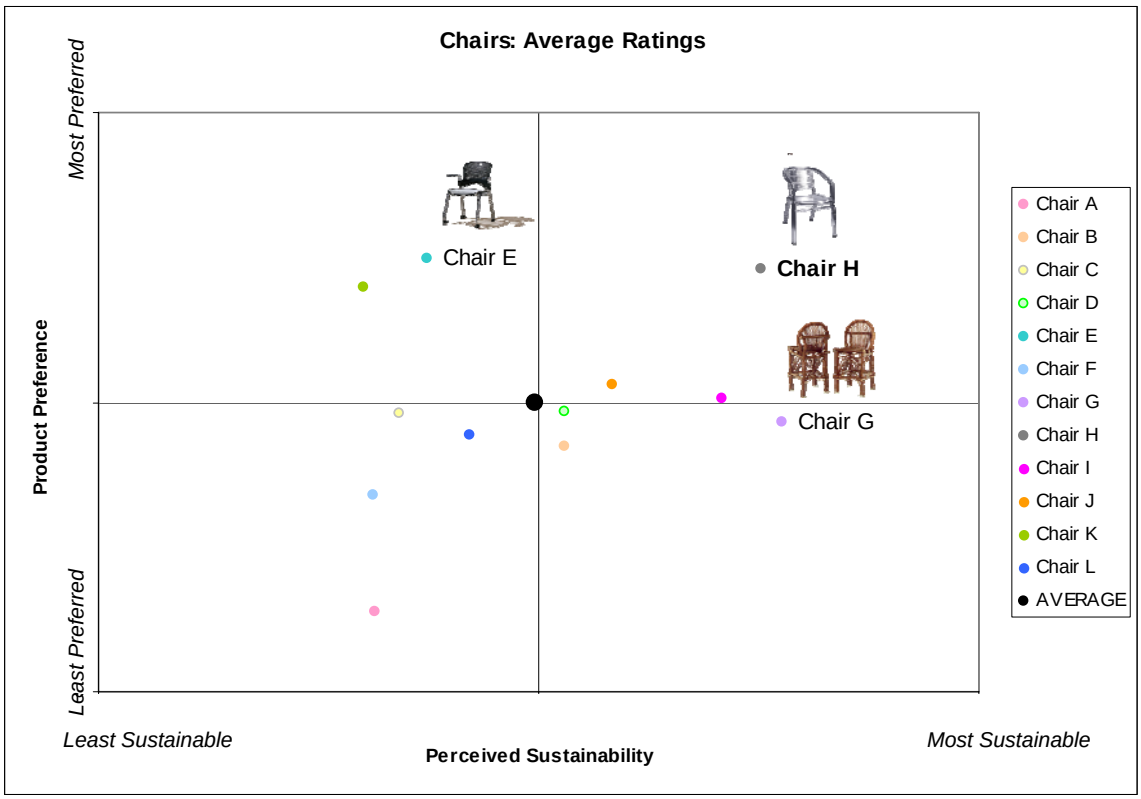


Figure 25. Average Ratings for All Chairs

The average ratings for chairs were relatively evenly distributed around the neutral axes. Chair E, pictured above, was the most preferred product choice. Chair G, also pictured above, was the highest scoring product on the scale of sustainability. The product that scored the highest on both axes combined was Chair H. This is the only case in any of the categories where the highest scoring product was not the most sustainable or most preferred choice as well. Table 25 below catalogues the number of times the top six products appeared in the upper right quadrant, indicating that they had a positive rating in both perceived sustainability and subject preference. Table 26 shows the products that scored above the category average, below.

Table 25. Top Five Chairs based on Frequency of Appearance in the Upper Right Quadrant.

Chair		Frequency
H		4
G		2
I		2
J		2
E		1

Table 26. Products with Above Average Total Scores in the Chair Category

Chair		Score
H		2.79
G		1.39
I		1.24
E		0.76
J		0.67
D		0.09
K		0.07

The number of times the product appeared in the upper right corner correlates well with the total score for all products presented here. Chair H, the top scoring product, was placed in the upper right quadrant twice as many times as the next product on the list.

Most subjects surveying this category cited materials and durability as the main criteria for judging sustainability, while personal preference was based on ‘comfort’ and ‘simple design’. Four of the seven surveyed for this category believed that wood was the most sustainable material choice, followed by metals and then plastics. A quarter of the respondents stated they believed complex, multi-material parts were less sustainable than single-material parts. Chair H received the highest overall score, and subjects

stated that the durability and easy recycling of metal made it sustainable while the modern, simple, and functional aesthetic was preferable to them.

The vocabulary used to describe this category set consisted of 71 unique terms, with the most popular listed in Table 27 below.

Table 27. Popular Terms used to describe Products in the Chair Category.

Term	Frequency
Plastic	11
Minimalist	9
Wood	9
Manmade	8
Metal	8
Modern	8

The vocabulary choices are split fairly evenly between perceived product characteristics and attribute expedients. The specific vocabulary terms used to describe the above average product choices appear in Table 28 below.

Table 28. Vocabulary Used for the Top Products in the Lamp Category.

H		G		I		J		E		D	
Metal	5	Wood	4	Wood	4	Minimalist	4	Professional	5	Old	2
Recyclable	2	Natural	3	High Quality	3	Modern	3	Functional	2	Decorative	2
Sensible	2	Organic	3	Handmade	3	Rigid	2	Comfortable	2	Outdated	2
Easy to Use	1	Handmade	2	Ornate	2	Simple	2	Recyclable	1	Busy	2
Sleek	1	Rough	2	Masculine	2	Plastic	1	Complex	1	Feminine	1
Inexpensive	1	Raw	2	Old	2	Boring	1	Light	1	Boring	1
Durable	1	Calm	1	Elegant	2	Dull	1	Plastic	1	Sensible	1
Minimalist	1	Rugged	1	Outdated	2	Recyclable	1	Metal	1	Beautiful	1
Clean	1	Imperfect	1	Solid	2	High Quality	1	Efficient	1	Pure	1
Functional	1	Recyclable	1	Heavy	2	Metal	1	Refined	1	Professional	1
Professional	1	Manmade	1	Expensive	2	Clean	1	Sensible	1	Manmade	1
				Hard	1	Hard	1	Flexible	1	Complex	1
				Durable	1	Glossy	1	Mechanical	1	Comfortable	1
				Beautiful	1	Elegant	1			Wood	1
				Decorative	1	Sleek	1			Refined	1
				Comfortable	1	Curved	1			Ornate	1
				Manmade	1					Soft	1
				Complex	1					Ugly	1
	17		21		33		23		19		22

The only terms that appeared more than twice among the top five in this category were *recyclable* and *metal,* and they were used five and seven times, respectively to describe three separate items.

CHAPTER 5: ANALYSIS

5.1 – GENERAL ANALYSIS TRENDS

Subjects' perception of sustainability for each category was governed by a few key product characteristics, such as material choice, form, and context of use. Material choice was universally acknowledged as a deciding sustainable factor for each product category, although the definition of sustainable materials changed some depending on the category. For example, while wood products generally received a high sustainability rating, Mug B received a relatively low sustainability rating due to the nature of its use in that category. Certain 'sustainable forms' emerged as well. Some of these forms were holistic in nature, representing the subjects' overall perception of the form, while others were details within the product, such as joinery or finishing techniques that communicated sustainability or unsustainability to the subjects. An example of the holistic product view emerged in the lamp category. Two of the leading products in this category, Lamp H and Lamp D, were cited as sustainable products because of their overall form language rather than their material properties. The detail-centered communication appeared in the Chair category; Chair G was cited as a sustainable product not because it was made from wood, but also because the joinery was simple and appeared to be easy to disassemble. Conversely, while metal products rated relatively high for sustainability in the spatula category, some subjects gave Spatula C a lower score based on the glossy finish; this was certainly a case where the finishing details lowered subjects' perception about the products sustainability. The context of use also appeared to affect the subjects' perception of sustainability and contained several aspects, such as materials perception, expected lifespan, and addition valuation factors. As previously mentioned, subject perception of materials changed based on the

category, depending on their context. Another contextual factor was the products' expected lifespan. For instance, the shoe and spatula categories had short-term life spans, average use lasting from approximately one to five years. The other three categories contain products that can be used for longer periods of time, possibly seeing decades of use. These long term use products had more opportunities for use past the initial product acquisition; they might be resold, modified for a different purpose, or passed down as an heirloom item. Subjects also stated that they gave higher ratings to products with value as an art object; two examples would be Mug B and Lamp H. These products received higher sustainability ratings because subjects believed they could be used as sculptural or display pieces even if their original functionality no longer existed. These three major criteria can be evaluated for each product category to get a better idea which materials, forms, and contextual factors can be used to convey the sustainability of those products.

5.2 –ANALYSIS OF INDIVIDUAL PRODUCT CATEGORIES

5.2.1 – Spatulas

Subjects who surveyed the Spatula category defined sustainability for these products based on the general material category of the product and the perceived durability of the product. Subjects were able to verbalize their rationale about the materials used in the products both in the terms they used in the collage and the rationale which they expressed themselves. The high frequency of AEs in this particular category indicates that the subjects had an understanding of the materials used in these products, and could make distinctions about the sustainability of these products based on the

materials. In fact, subjects based their rating of this category's sustainability almost entirely in the material properties of the products. Form language that received positive response was defined by the use of PPCs such as *modern*, *refined*, and *simple*. Subjects preferred products that were easy to understand and use, but were also comfortable as well. Spatula F, the simplest design, received a below-average score for poor ergonomics although it technically met many other positive criteria. These positive criteria for simple, functional, and durable products can be linked back to the context of use for these products. Spatulas are utilitarian products that must withstand exposure to heat and a variety of substances; therefore, it is reasonable that while there was some preference based on the aesthetics of the product, the majority of subjects' preferences were based around the products' functionality. Given these criteria, the primary areas of consideration for sustainable designers in this category would be material choice and the functionality of the product.

5.2.2 – Mugs

Subjects who surveyed the Mug category tended to define sustainability for these products through the materials used, with some attention paid to the expected lifespan of the product. While durability was mentioned as a positive trait of Mug J, most products in this category were not perceived to have high durability. While subjects were again able to verbalize their rationale for most materials, ceramics posed a challenge to them, although overall they had a positive sustainable perception of that material. This confusion, along with the fact that the words *ceramic* and *glass* were not included in the basic vocabulary sheet, may account for the lack of AEs present in the descriptors of the

top five products. Preferred form language was expressed in terms such as *functional*, *high quality*, and *simple*. Much like the Spatula category, these terms correspond with the context of use for these products. Since these products are generally utilitarian objects that are used every day, their function and ease of use are a higher priority than their aesthetic value in most cases. However, in the case of Mug H, the context of use is slightly different than most other products in this category. While almost all subjects indicated that this mug was fragile, and many used words such as *elegant*, *heirloom*, *ornate*, and *decorative* to describe it, it still received a score above the category average. These attributes, almost contradictory to the preferred form language, make sense when the added value of Mug H as a legacy object was considered. These results add another consideration for the sustainable designer, giving them the opportunity to increase the perceived sustainability of a product depending on the context of its use.

5.2.3 – Boots

The Boot category was one of the most difficult for the subjects. The main definition for sustainability that emerged in this category was not based heavily in the material properties of the product, but in the durability and versatility of the products. Few AEs were used to describe products in this category. The use of PPCs to describe these products may be explained two ways. Subjects recognized that the boots were made from a wide variety of complex materials, although they were not able to identify the materials individually. Secondly, the products must be considered in context. The subject population often owns more than one pair of shoes at a time, and this multiplicity is due to both functional requirements and more commonly aesthetic preference. This stronger aesthetic preference drives subjects to choose products based on the look of the

product, as opposed to the materials it is made from. For instance, the top choices in this category were described by terms such as high quality, masculine, and functional. Boot L, the top scoring choice, was preferred for its versatility as both a professional and casual boot, as well as its simple styling which would go with many outfits and would be worn often. Subjects ranked the boots on the basis of durability, versatility, and aesthetic preference because there were no other obvious indicators of sustainability to motivate their choices. Indeed, those products that presented themselves as sustainable (Boot J) were met with skepticism and distrust. Subjects also made choices based on factors outside the actual manifestation of the product, such as the product's brand, which showed itself to be both a positive and negative factor in their rationale. This category certainly presents a challenge for the sustainable designer, and perhaps begins to hint at the larger challenges inherent to products that are made from complex materials.

5.2.4 – Lamps

The definition of sustainability that came from the Lamp category was based on subjects' perceived natural aesthetic of the product, instead of their actual identification of constituent materials, as well as the products' potential added value as an art object. This was the only category that contained metal products that actually received the lowest sustainability scores for the category, which indicates that subjects used a different evaluation paradigm than they used for other product categories. This category has a strong positive correlation between the two axes, which can be interpreted one of two ways. Either subjects, without many definable material choices, decided to base their choices on preference only, or they actually prefer their interpretation of sustainable form language. The subjects themselves point towards the latter interpretation. They

describe the two highest rated lamps almost exclusively in terms of PPCs using similar terminology, such as *simple*, *pure*, *calm*, and *natural*. When asked to describe their preference for these products, subjects mentioned the overall form of the lamp, the fact that they seemed to be made out of natural materials such as stone, and the quality of the light emitted from the lamp. Subjects did not mention terms such as *durable* or *functional* at all for the top two lamps, although both of those terms were top criteria in all the other products surveyed. This may go back to the context of these products; free-standing lamps are used in the living environment for both their functionality and aesthetic value, although the type of interaction usually associated with these products does not require that they withstand the same type of daily use and conditions as the other products surveyed. The terms used to describe the top two lamps also reinforce the subjects' statement that these products also had artistic value, so much so they would consider keeping these products as art pieces even if they no longer functioned as lamps. This category presents significant interest to the sustainable designer as an example of how the holistic view of a product's semantic language can shape consumers' ideas about the product's sustainability, and what sort of positive traits they associate with sustainability.

5.2.5 – Chairs

The rationale subjects used to rate products in the chair category was based mainly on materials, although this trend was not so prominent as in other product categories such as Spatulas and Mugs. Besides judging the products' materials, subjects also rated the products based on their ergonomics and durability. Again, wood and metal were the products with the highest total scores for this category, and for the most part single-

material products received higher sustainability scores than multi-material products. However, some notable exceptions, such as Chair E and Chair B, show that ergonomics play an important role in this product area as well. Chair E, while being a complex product with multiple synthetic materials received a high total score based primarily on its perceived comfort. Chair B, while made from a single, natural material, received relatively low total scores because subjects thought it would be uncomfortable. In terms of form language, there was not the same degree of consistency among the top five choices as there were in the other categories. The products that received the first and fourth highest total scores had a very modern aesthetic, while the second and third highest scores had a more rustic and old-fashioned aesthetic. Each was chosen for different reasons, each of which had been echoed in other categories. Chair H was the highest scoring product due to its simple aesthetic and simple, single material build and durability, all preferences voiced in both the Spatula and Mug category. The second product, Chair G, was preferred for its simple, single material build as well, but also received high scores for sustainability because it was made out of natural, relatively unprocessed wood and was relatively easy to disassemble, a rationale which also appeared in the Spatula category. Chair I was ranked third because of its wooden construction, it's perceived comfort, as well as its potential to as a legacy object; many subjects believed it to be a sturdy, antique item that would be passed down through families for many years of use. These varied rationales highlight the chair's complex contextual model; indeed, other products categories surveyed here, such as lamps and mugs, also fulfill a variety of different roles from the everyday functional product to the aesthetically pleasing art object, to the heirloom piece full of memory and emotional significance. Each of these roles reflects Norman's semantic channels of behavioral, reflective, and visceral communication, respectively. Given this knowledge, the

sustainable designer can design products for each level of communication, appealing to the consumer on many different levels.

5.3 – GENERAL CONCLUSIONS

There were many commonalities among the surveyed product categories. Subjects had a tendency to define sustainability based on the durability of the products; this trend was most evident in utilitarian items such as spatulas and mugs. They also defined sustainability based on the material composition of the products; this trend was more evident in categories that had simple products where the constituent materials were easy to identify. Subjects maintained a fairly consistent materials ranking throughout the categories, with wood and metal being considered the most sustainable materials. Vocabulary and rationale for the categories maintained some consistency as well; the PPCs *modern*, *functional*, *durable*, and *simple* all appeared in the top ten most frequently used terms, and were mentioned consistently when subjects described their rationale for preferences in each category. These trends in materials and described preferences extend through all the categories, with a few notable exceptions.

While subjects were consistent with much of their rationale for materials and descriptive terms, there were a few distinct differences as well. There were a few points of divergence for both rating scales in each category; these variations were justified through the product's form language and context of use. Form language shifted subjects' perceptions of various materials, both in a positive and negative way. For instance, while Lamp I was made from metal and glass, both materials that received high sustainability scores in the Mug category it received a low sustainability rating based on subjects'

negative perception of its form language: *old*, *heavy*, and *ugly*. Conversely, Lamps B and E, while made from plastics, which garnered low scores in the other categories, were described by positive terms such as *fun*, *unique*, and *modern*, all PPCs described the subjects' reaction to those lamps' form language. Context of use for each overall category also shifted subject ratings as well. Utilitarian products, such as Spatulas and most Mugs, received high preference scores if they communicated simplicity, ease of use, and durability. Aesthetically driven products, such as many of the Boots, some Chairs, and some Lamps received high preference scores based on how they looked as opposed to their composition or perception of performance. And finally, legacy products mark the last contextual category; these products received high scores based on their ability to move through generations of users, either through their durable construction or classic form language. By observing both the consistencies and exceptions the subjects formed for each category and all the categories in general, the sustainable designer can begin to form sustainable design guidelines around these different areas to develop and promote sustainable products.

There are many conclusions that can be drawn from the research findings. While each of the categories had unique results, there were some common themes among subjects regarding their perceptions of sustainable products. These themes can be developed into a set of guidelines for the sustainable designer that highlight areas of consumer interest that they must develop in order to meet or exceed consumer expectations of sustainable products.

CHAPTER 6: REFLECTIONS

6.1 – STRENGTHS OF THIS METHODOLOGY

The methodology used in this research exercise has many strong points which make it a solid choice for evaluating consumer perceptions and acceptance of sustainable products. The three-fold research method allows the researcher to collect data in such a way that they gather data that yields general results for any product in any category as well as detailed results for the various products, relative to other products in the category. The questionnaire allows the researcher to capture demographic data, as well as a basic understanding of the consumer's sustainable (or unsustainable) habits. The brainstorm captures the subjects' first impressions and biases about sustainability while coaxing them into thinking critically about the subject. And finally, the collage exercises provide a thorough but engaging way to capture their impressions of specific products. The information yielded by these three research methods overlaps to ascertain the validity of results, and allows the researcher to investigate individual subject remarks more deeply as the exercise progresses. The methodology is also versatile; while this version of the methodology tests five different categories of products it could be broadened to evaluate families of similar products or focused to evaluate only one product and its direct competitors. While not the focus of this study, the methodology could also be adapted to evaluate consumer perceptions of product attributes other than sustainability. Overall, the template provided by this methodology is an effective, multilayered approach to understanding consumer perceptions about sustainable products.

6.2 – WEAKNESSES OF THIS METHODOLOGY

While the methodology itself is very versatile and can be adapted to a variety of needs, this particular implementation had a few limitations, in the way the method was administered and some of the content itself. The sample population was skewed towards college-aged males that lived in an urban setting. The sample population was also relatively small, at seventeen participants; both of these conditions reduced the accuracy of the method. Another limitation, while not in the actual administration of the methodology, was in the content itself. This particular methodology focused only on general consumer preference and their perception of sustainability, without regard to product cost or other factors which would realistically affect consumers' purchasing habits. While the scope of this material is appropriate for the objective of obtaining a basic understanding of sustainable product semantics that consumers both like and dislike, the consideration of cost and other more subtle communication channels such as branding is important. Cost, as a primary concern for potential sustainable consumers, emerged over and over again in the preliminary research, the pilot surveys, and the final research instrument as well. Branding can also have a big impact on consumers' perception of the product by skewing their opinions in both positive and negative ways, as evidenced by subject comments for this exercise. This study provided no product information or packaging to the user beyond the provided images, which might also affect subject ratings as well. While none of these limitations are crippling to the method itself, they are issues that must be considered when analyzing the results for this particular exercise or adapting the method for further use.

6.3 – CONSIDERATIONS FOR FURTHER DEVELOPMENT

Analyzing the results of this methodology revealed that a few relatively simple refinements could greatly add to the validity and understanding of material gleaned from this exercise. One refinement that would be straightforward to implement would be expanding the questionnaire to include more questions, specifically focusing on consumer's knowledge and level of commitment to sustainability. For instance, one of the pilot surveys included a question ranking sustainability among other common concerns when purchasing products. While not directly related to communicating sustainability itself, this sort of evaluation can aid the designer in prioritizing various consumer concerns in their product design. Another opportunity for refinement would be the inclusion of electronics and energy-focused products. While Lamps were included in this exercise, the main criteria set for this exercise excluded most energy-focused products and complicated products. These products were excluded because their function was not transparent to users, and misinterpretation of these products' function and materials would likely alter the subjects' scores of the products' sustainability. While helpful in evaluating this methodology, it is overly simplistic to restrict this methodology only to products that meet the criteria for this trial evaluation.

The next step in expanding the validity and utility of this method is to evaluate the results using Veryzer's formula, using those results to fuel an iterative design process. Veryzer's formula was not applied to the methodology here since multiple product categories were evaluated. Veryzer's method is built to evaluate a specific product or constellation of related products, which is still an appropriate application of this methodology. By integrating Veryzer's method, this new methodology provides a way for sustainable

designers to keep track of the specific product semantics that are being communicated by their designs, giving them insight into what forms, materials, and aesthetic properties communicate their intended message. The ultimate goal for the sustainable designer in using this methodology is to aid the designer in the development a lexicon of sustainable product semantics, allowing them to apply these semantics to products thereby communicating these attributes to users.

CHAPTER 7: RECOMMENDATIONS FOR THE SUSTAINABLE DESIGNER

The methods presented in this study provide the sustainable designer with design guidelines that they may use to create sustainable products that communicate their sustainable attributes. Also, the methodology gives the sustainable designer the opportunity to further explore various types of products in order to gain a better understanding of the underlying trends uncovered in this implementation of the research instrument. Sustainable designers, beyond their normal design efforts, must investigate the three areas of form, material choice, and context of use. These areas of inquiry, with specific questions that arose from findings in the research, are detailed in Figure 26. These areas are opportunities for the sustainable designer to make decisions that will allow the product to communicate its sustainable properties. While not all the questions that arise in these areas are appropriate for application in all circumstances, a rational survey of these subjects will provide the sustainable designer with inspiration for their particular product design challenges. Materials selection, for instance, is an opportunity for the sustainable designer to consider new, more sustainable materials for a product that is typically made from a less sustainable counterpart. Form language might include design cues inspired by nature, or simply form language that follows terms consumers associate with sustainable products. Context of use is the last area of consideration, but perhaps the most important; sustainable products are future-oriented artifacts that need to break the consumption cycle, and therefore must communicate to the user and function differently than their unsustainable rivals. All these aspects of the product must be thoughtfully considered if the sustainable designer is to be successful in establishing sustainable products that will speak to consumers and affect their way of life.

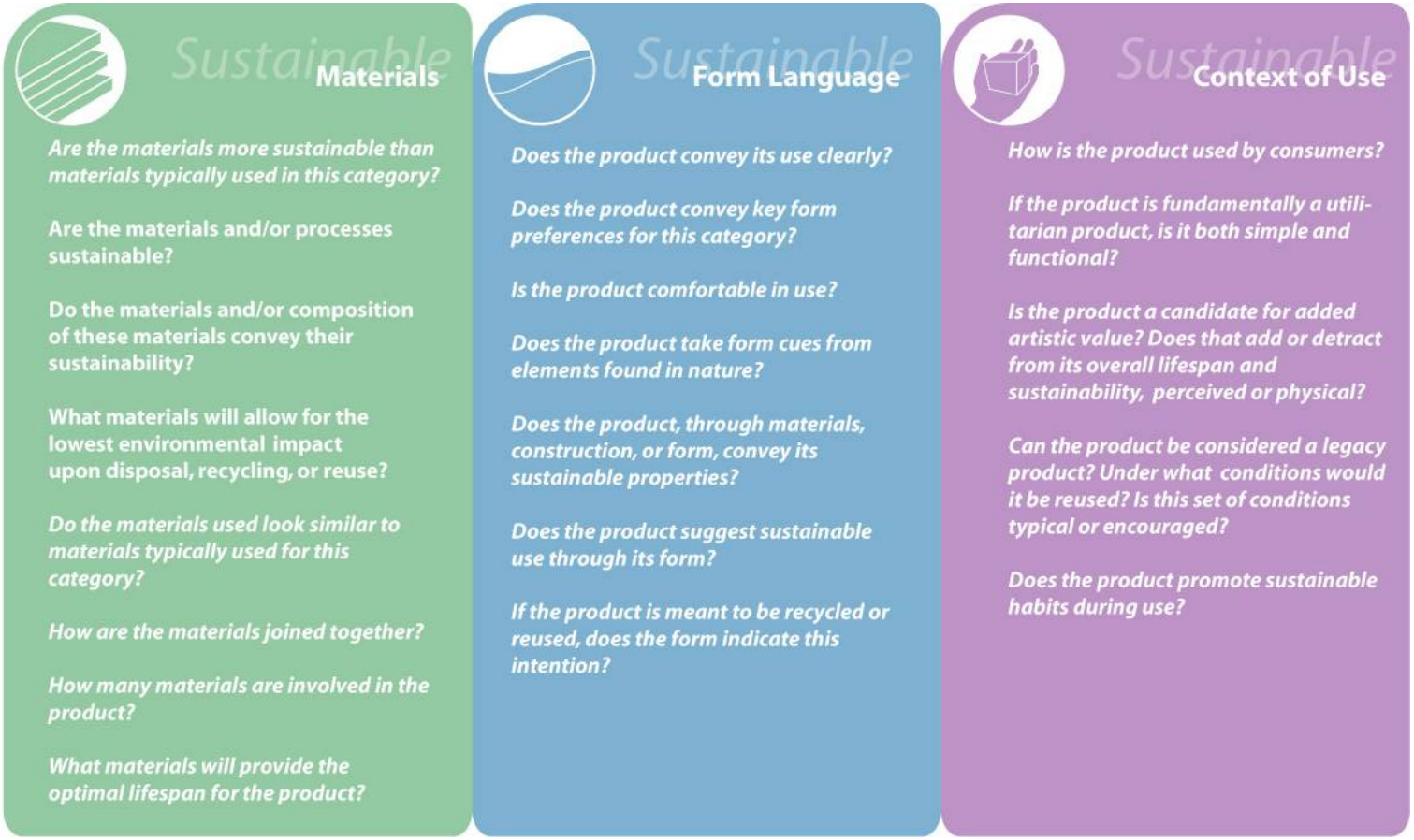


Figure 26. Areas of Inquiry for Sustainable Product Semantics Design

Sustainability is not a passing fad in the design world; it is a real, cohesive movement that is slowly taking shape and moving us forward into a new level of understanding of how our products affect our lives. Consumers are becoming more sensitive to environmental issues, which affects their purchasing habits. Businesses are mobilizing to include sustainable philosophies and methods in their corporate structure. Industrial designers, stakeholders at the heart of this production – consumption cycle, are also beginning to examine sustainability and understand how it can be implemented into their design efforts. It is the purpose of this study to assist the designer in both understanding and implementation of sustainable tenets in their designs. By implementing product semantic research and examining current products and consumers' reactions to those products, this research starts to piece together the puzzle that is sustainable product design. The key is not only to produce sustainable products, but to produce sustainable products that engage the user, capturing their hearts and their wallet, and motivate the user to at least understand and consider sustainable practices, or at best embrace those practices. This is a complex and subtle task, and sustainable designers have a myriad of new design issues to consider when they undertake it. However, this methodology, in the spirit of sustainability, attempts to provide a starting point with the flexibility to adapt and grow into a useful tool for any sustainable designer to successfully bring products to consumers that allow them to diminish the damage they inflict on the world.

APPENDIX A: RESEARCH INSTRUMENT DOCUMENTATION

Research Instrument Outline

Phase 1 – Questionnaire (5 - 10 min.)
Materials:
Consent Form
Questionnaire
Writing instrument

Phase 2 & 3 – Word Association & Collage Exercise (5 min., then 15 - 20 min. per sheet, 3 total for 45 – 60 min.)
Materials:
Newsprint (with packet designation on the back)
Paste or Tape
Markers (one set per person, same colors)
Vocabulary Set (approx. 70 - 80 words) plus 10 blanks
3 Product Categories, 12 per set (random set in packet)
Refreshments – soda and snack food

Procedure:
Phase 1: Participants will first fill out the short questionnaire that comes in their packet.

Phase 2: I'll ask participants what comes to mind when they think of the word 'sustainable' (definition provided on the questionnaire). We'll jot down all the terms that come to mind.

Phase 3: Participants will then be asked to open their packets, and take out a sheet of newsprint, the paste, markers, words, the vocabulary set, plus one product category.

Participants will be asked to divide up the newsprint similar to the following:

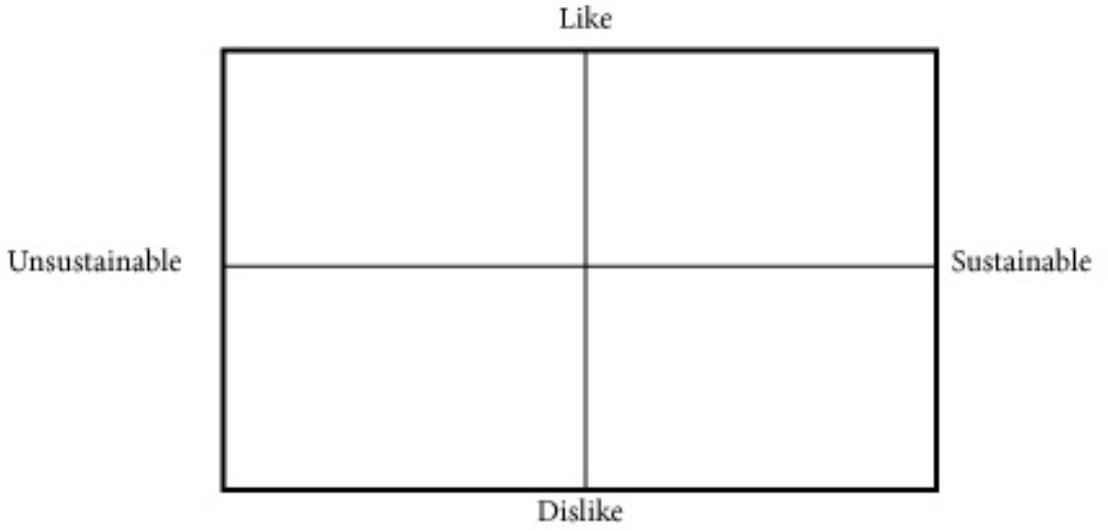


Figure 27. Research Instrument Procedure Outline.

Participants will be asked to populate the paper with the twelve products (and accompanying terms), based on the images and their opinions and observations about the products. They will be asked to place the products in the quadrants based on the intensity of their associated impression (i.e., Very Good, Very Unsustainable, etc.). Finally, they will be asked to circle the most sustainable product in green and the least sustainable product in red.

The participants will be asked to explain their general choices and rationale (to get an idea of why they liked what they liked) and then be asked to talk about their most and least sustainable products in detail.

This activity will need to be video taped.

Figure 27. Continued.

Research Activity Consent

Read the provided information carefully.

Georgia Institute of Technology
Questionnaire: Consumer Perceptions about Product Communication
Investigators: Dr. Wayne Chung and Mrs. Allison Amis Guyton

You are being asked to be a volunteer in a research activity. This activity is part of a research study investigating consumer perceptions about sustainable products, and what aspects of a product communicate sustainability. This particular activity is expected to be completed by approximately 20 subjects, and involves a short questionnaire and group research activity. The activity's general theme includes questions about attitudes towards sustainability, individual opinions about sustainability, and individual opinions about products.

If you decide to be in this study, you will be asked to fill out a questionnaire, participate in a short group discussion about sustainability, make three collages involving a set of products and vocabulary, and finally to provide a short explanation of the collages you make. You will complete the research activity based on your personal knowledge and experience only. The questionnaire should take approximately 5 minutes to complete. The group activities will involve no greater than five other individuals, in addition to the researcher. If you prefer to conduct the research activity without other participants present, alternative accomodations will be provided for you. The group discussion will take approximately 10 minutes, and each collage will take approximately 20 minutes. The research activity will last for approximately 60 minutes but no longer than 90 minutes.

You will not be asked to participate in any other aspect of this research project in the future. The risks involved are no greater than those involved in daily activities. If at any time you wish to discontinue your participation, you may do so and your answers will destroyed and will not be included in the survey results.

You are not likely to benefit in any way from participating in this activity.

The following procedures will be followed to keep your personal information confidential in this study:
The data that is collected about you will be kept private to the extent allowed by law. To protect your privacy, your records will be kept under a code number rather than by name. Your records will be kept in locked files and only study staff will be allowed to look at them. Your name and any other fact that might point to you will not appear when results of this study are presented or published. All video taped sessions will be kept under lock and key for the duration of the research study then destroyed upon completion of the study, no later than August 31, 2006.

To make sure that this research is being carried out in the proper way, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look at study records.

There will be no cost to the participant to participate in this study. If you are injured as a result of being in this study, please contact Mrs. Allison Guyton at telephone (404) 374-9575. Neither the Principal Investigator nor Georgia Institute of Technology have made provision for payment of costs associated with any injury resulting form participation in this study.

Your participation in this study is completely voluntary, and will remain confidential. These results will only be published as part of a larger body of data, and not as an individual document.

Subject Rights
- Your participation in this study is voluntary. You do not have to be in this study if you don't want to be.
- You have the right to change your mind and leave the study at any time without giving any reason, and without penalty.
- Any new information that may make you change your mind about being in this study will be given to you.
- You will be given a copy of this consent form to keep.
- You do not waive any of your legal rights by signing this consent form.

If you have any questions about the study, you may contact Dr. Wayne Chung at telephone (404) 385-4982.
If you have any questions about your rights as a research subject you may contact:
Ms. Melanie Clark
Office of Research Compliance
Georgia Institute of Technology
(404) 894-6942

Mrs. Allison Guyton
Georgia Institute of Technology
Industrial Design Department
247 4th St, Rm. 156
Atlanta, GA 30332-0155
phone: 404.374.9575

_____

Signature Date

By signing this consent form I agree to participate in this study

Figure 28. Research Instrument Consent Form.

Questionnaire (5 - 10 min.)

Sustainability: To meet the needs of today without compromising the ability of future generations to meet their needs.

While no product truly meets these standards as of yet, many products are being designed with this goal in mind.

Age: _____

Gender (circle one): Male Female

1. How important is sustainability to you?
   a. Very important
   b. Somewhat important
   c. Not very important
   d. Not at all important

2. Do you purchase sustainable products?
   a. Yes
   b. No

3. Why do you purchase sustainable items? Or circle: N/A

   _____

   _____

   _____

4. How much are you willing to pay for sustainable products? Or circle: N/A
   a. I would pay a significant premium for sustainable products.
   b. I would pay a slight premium for sustainable products.
   c. I would only buy sustainable products if they were priced competitively to other products
   d. I'll only buy sustainable products if they are cheaper than other products.
   e. I would never purchase sustainable products.

Figure 29. Questionnaire.

Elegant
Hand made
Recyclable
Organic
Rough
Imperfect
Flawed
Unique
Toxic
Easy to use
Hard to use
Low quality
High quality
Bright
Efficient
Masculine
Lazy
Sensible
Plastic
Wood
Metal
Dull
Old
Pure
Rugged
Juvenile
Angular
Sinuous
Beautiful
Ugly
Solid
Mechanical
Dull
Calm
Busy
Playful

Professional
Aggressive
Submissive
Fun
Boring
Healthy
Unhealthy
Masculine
Feminine
Active
Passive
Sleek
Rugged
Ordered
Disordered
Expensive
Inexpensive
Controlled
Uncontrolled
Simple
Complex
Rounded
Angular
Raw
Refined
Heavy
Light
Durable
Strong
Fragile
Weak
Flexible
Rigid
Curved
Straight
Organic

Man-made
Geometric
Amorphous
Minimalist
Ornate
Comfortable
Uncomfortable
Outdoors
Urban
Decorative
Functional
Stylish
Modern
Out-dated
Industrial
Sophisticated
Unrefined
High Tech
Natural
Soft
Hard
Drab
Bright
Rough
Smooth
Natural
Synthetic
Imperfect
Perfect
Dirty
Clean
Rubbery
Fuzzy
Glossy
Matte

Figure 30. Vocabulary List for Collage Exercise.

Figure 31. Spatula Product Category Images.

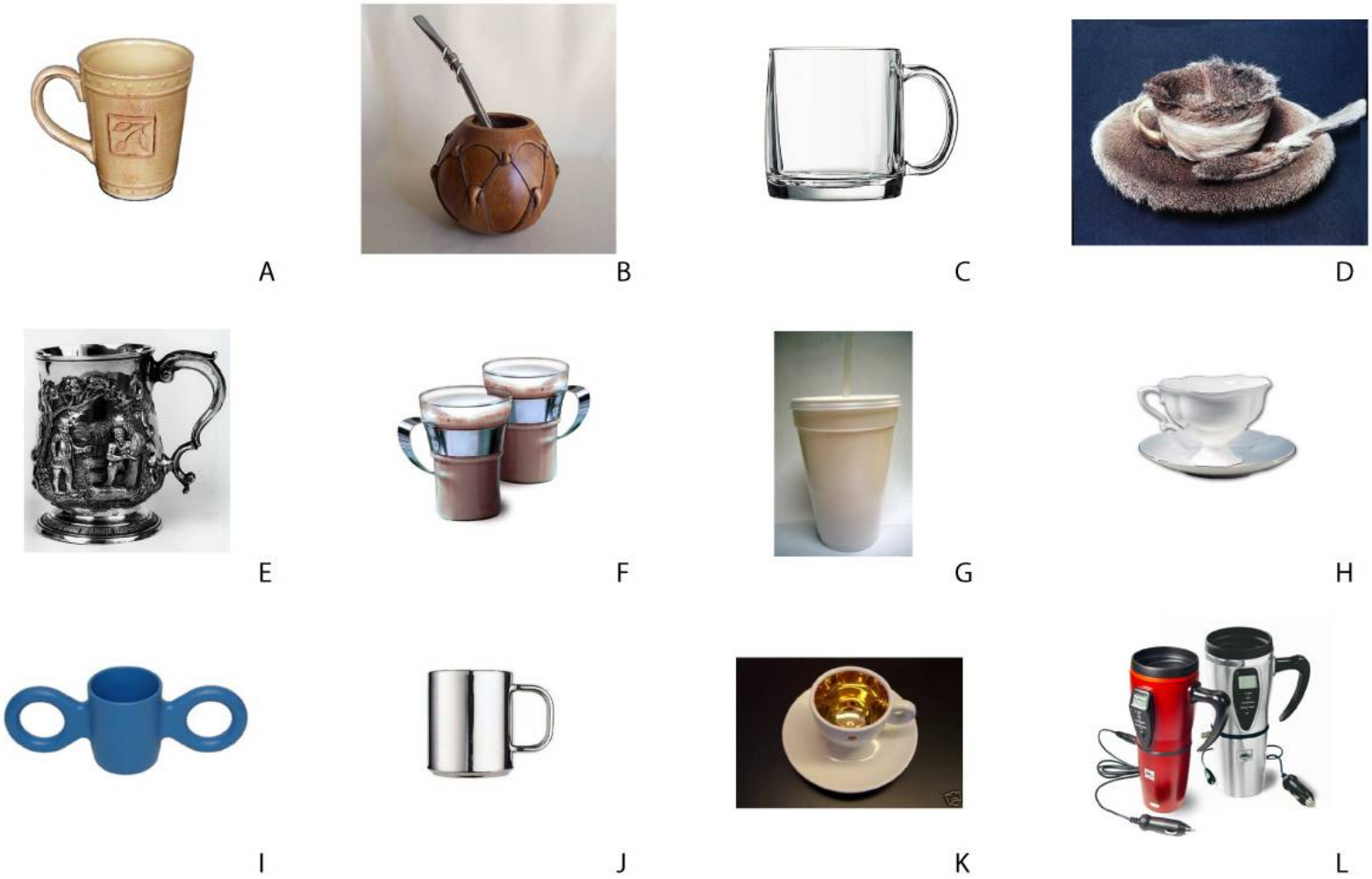


Figure 32. Mug Product Category Images.

Figure 33. Boot Product Category Images.

Figure 34. Lamp Product Category Images.

A

B

C

D

E

F

G

H

I

J

K

L

Figure 35. Chair Product Category Images.

APPENDIX B: RAW DATA FROM RESEARCH INSTRUMENT

Table 29. Raw Data from Questionnaire.

	Subject Designation	Gender	Age	Q1: Importance	Q2: Purchase	Q3: Why? (PARAPHRASED)	Q4: How much?	C1	C2	C3
1	S1M001	M	23	2	Y	I don't generally make buying decisions based on sustainability, but if a product happens to be environmentally fr	0	M	S	
1	S1M002	M	26	2	Y	Making the world a 'better' place for our children but still able to enjoy today's life	1	S	B	
1	S2F001	F	27	3	Y	It is important for the future, and a change in consumption is needed	1	B	L	C
1	S2M003	M	22	2	N	Purchase them when pricing isn't outrageous b/c why be harmful if it isn't even cost effective	0	C	M	L
1	S3M004	M	20	2	Y	They are effective	0	S	C	B
1	S3M005	M	34	3	Y	Would like to decrease my footprint on the environment	0	S	M	B
1	S4F002	F	29	2	Y	Feel responsibility as a designer to support these ideals	1	L	S	M
1	S4M006	M	23	2	Y	If the cost is equivalent or better and functionality equivalent or better I buy them	0	M	C	B
1	S5F003	F	22	2	Y	I appreciate steps that companies take to innovate in this area	0	L	S	B
1	S5M007	M	22	2	Y	If they are comparably priced and similar quality. The environmental benefits are good.	0	M	S	C
1	S5M008	M	22	2	Y	Makes me feel like I'm making a (small) difference	1	B	L	M
1	S6F004	F	21	2	N	Will purchase in the future	1	S	M	L
1	S6M009	M	20	2	Y	The products are better for the environment and promote industry to move toward sustainability	1	L	B	C
1	S7M010	M	23	2	N	N/A	1	S	M	L
1	S8F005	F	20	2	Y	I think it is important for us to preserve the earth for future generations and keep it clean - a clean earth is a healt	1	C	L	S
1	S8M011	M	27	2	Y	To feel better about my personal 'footprint' on the earth and its future. Also, because they often last longer, save	1	M	S	B
16		M: 68.75% F: 31.25%	23.8	2.125 2.2 2.1 2: 87.5% 3: 12.5% 3: 20% 2: 80% 3: 9.1% 2: 90.9%	Y: 81.25% N: 18.75% Y: 80% N:20% Y: 81.8% N: 18.2%		0.5625 0.8 0.45454545			

Q1
3 Very important
2 Somewhat important
1 Not very important
0 Not at all important

Q4
2 Significant premium
1 Slight premium
0 Competitive price
-1 Cheaper
N Never purchase

Table 30. Vocabulary Terms from Session 2.

S2	
General:	green
	long-lasting
	low energy production
	hemp
	hippies
	biodegradable
	reuse
	recyclable
	granola eating people
	re___able
Positive:	healthy
	non-toxic
	resource friendly
Negative:	expensive
	guilt trip
	hard to find

Table 31. Vocabulary Terms from Session 3.

S3	
General:	green
	compatible
	recyclable
	reusable
	cradle to cradle
	useful
	robust
Positive:	healthy
	longevity
	low pollution
Negative:	negative perception
	brown
	expensive
	not always high tech
	ugly
	irrelevant
	incompatible

Table 32. Vocabulary Terms from Session 4.

S4	
General:	green
	environmentally responsible
	renewable
	low-impact
	no impact
	earth friendly
Positive:	profitable
	Premium price
Negative:	greenwash
	spin
	ignorance
	tricked

Table 33. Vocabulary Terms from Session 5.

S5	
General:	green
	recycle
	non-synthetic
	future-oriented
	eco-friendly
	expensive
Positive:	Save resources
	smarter
	efficient
Negative:	unrealistic
	ugly

.

Table 34. Vocabulary Terms from Session 6.

S6	
General:	environmental eco-friendly earth day non-polluting biodegradable
Positive:	helpful (environment, future) progressive
Negative:	too much research - industry expensive unneccessary hippie backwards old-fashioned

Table 35. Vocabulary Terms from Session 7.

S7	
General:	green recyclable low energy use renewable raw materials clean
Positive:	environmentally conscious chance to decompose cheaper (energy)
Negative:	expensive looks like it's going to crumble poor longevity hippie-looking

Table 36. Word Categorization and Tally.

	Term	Frequency
	green	5
Durability of Product	long-lasting	1
	robust	1
	longevity	1
	looks like it's going to crumble	1
	poor longevity	1
Energy Use	low energy production	1
	efficient	1
	low energy use	1
	cheaper (energy)	1
Post Consumer Handling	**recyclable**	4
	biodegradable	2
	reuse	2
	re___able	1
	cradle to cradle	1
	chance to decompose	1
Consumer Viewpoint	**hippies**	3
	granola eating people	1
	greenwash	1
	spin	1
	ignorance	1
	tricked	1
	progressive	1
	negative perception	1
	backwards	1
	old-fashioned	1
Cost	**expensive**	6
	profitable	1
Product and Materials Perception	**ugly**	2
	healthy	2
	hemp	1
	non-toxic	1
	resource friendly	1
	not always high tech	1
	brown	1
	non-synthetic	1
	Save resources	1
	non-polluting	1
	clean	1
	low pollution	1
General	**renewable**	2
	guilt trip	1
	hard to find	1
	compatible	1
	useful	1
	irrelevant	1
	incompatible	1
	environmentally responsible	1
	low-impact	1
	no impact	1
	earth friendly	1
	future-oriented	1
	eco-friendly	1
	smarter	1
	unrealistic	1
	environmental	1
	eco-friendly	1
	earth day	1
	helpful (environment, future)	1
	too much research - industry	1
	unneccessary	1
	environmentally conscious	1

Table 37. Absolute Collage Image Placement, By Subject and Category

S1M001C1 Spatulas	
X	Y
6.5	5.25
16	11
16.5	15.5
21	15.5
14	9
12	11.5
11.75	14
3	6.25
19.25	10.25
6.75	15.5
11.5	6.5
12	4

S1M002C2 Spatulas	
X	Y
4.5	7.5
12	9.25
17	15
12	15.25
17.25	6
17	2.75
7.75	13.25
4	4.5
8.5	7
17	10.75
6.25	1.5
11.75	3

S3M004C1 Spatulas	
X	Y
5	12.5
7	10.25
19.25	16.25
14.5	16
23	16.5
22	1.5
17	16.25
8	13
22.25	10.25
13.5	7.25
6.75	8
13.25	10.5

S3M005C1 Spatulas	
X	Y
6.5	3.75
6	16.5
15.75	9.25
18	16.5
23	16.5
18.5	13.25
14.25	5
10	16.5
17.75	2.25
22	13.5
10.25	10.75
9.5	1.75

S4F002C2 Spatulas	
X	Y
9.25	7.5
5.25	4.25
21.25	15.5
9.25	14.5
17	16.5
21	7.25
5.25	11
14.25	12.5
14.5	10.25
21	11.75
5.25	7.5
9.5	11

S5F003C2 Spatulas	
X	Y
6.5	6.75
2	6.5
6.25	4.5
6.5	11.5
14	10.25
14.5	7
10.75	14.5
9.25	7.75
11	4.75
19.75	12
13	15.75
9	5

S5M007C3 Spatulas	
X	Y
7.75	6
1.5	1.25
12	14
5.25	8
8.5	10
20.25	7
12	7.75
5.25	4.75
11	1
17.5	11
5.25	1.75
8.5	1.75

S6F004C1 Spatulas	
X	Y
11.5	7.25
12	14.75
2.5	6.75
2	12.25
2.25	3
5.75	15.5
6.25	1.5
12	11.25
6.75	11.25
21.75	6.75
19	15
6.5	7

S1M002C1 Mugs	
X	Y
11.75	2.25
15	2.25
10.25	12.5
2	2.25
16	16
10.5	5.5
1	12.75
15.5	11.5
6.5	2.25
17.25	8.25
13.25	13.25
7	8.75

S2M003C2 Mugs	
X	Y
16	7
8.5	8.75
15.75	10.75
8.25	14
16	14.25
8.25	6
3.75	9
15.75	4.5
12	5.5
19.25	10.25
12	9
4	14

S3M005C2 Cups	
X	Y
18.5	11
20	5.5
10.25	11.5
5.5	1.75
15.25	11.25
15.25	16
4.5	5
20	3
15.75	13.5
21	11
9	5.75
1.75	2

S4F002C3 Cups	
X	Y
22	14.75
7	11
21.75	11.75
3.75	2.5
10.25	2.25
12.25	14.25
12	5.75
16.5	6.5
14	11.25
18.75	11.5
6.75	2.5
18.5	15.5

S4M006C1 Cups	
X	Y
14.25	10.5
7.5	2.75
19.5	15.25
3	2.5
9.25	12.75
14	13.5
3.5	11.75
16.75	13
12	2.5
19.25	12
10.25	10.5
6.5	15.75

S5M007C1 Cups	
X	Y
12.5	2.75
15.5	5
21	16.25
12	7
18	2
6	11.75
1	5.5
17	7.75
4.5	4.25
19	13.5
15	10.75
6	7

S5M008C3 Cups	
X	Y
13.5	5.25
14.25	8.25
22	15.75
12	12
5.25	9.5
17.5	7.5
1.25	16
16.75	13.5
8.25	7.25
19	16.25
16.5	15.25
2.75	2.25

S6F004C2 Cups	
X	Y
16.75	8.5
19.25	12
14	13.5
21.75	16
7.25	2.75
9.5	15.25
2.75	7.75
13.75	6
9.25	6.5
6	15.5
13.75	2.25
2	12.5

S1M001C2 Boots	
X	Y
2.75	5
16	8.25
12	14
8.75	14.25
9.25	11.5
12	16.5
14	5.5
13.25	9.25
8.25	9
4.75	2.5
16.75	2.5
13.5	11.5

S2F001C1 Boots	
X	Y
13.5	12.5
3.5	15.5
9.25	15.75
9	9.5
10.25	12.75
6.75	12.5
15	2
13.5	15.5
5	9.75
17.5	12.75
2.75	13
15.25	9.75

S3M004C3 Boots	
X	Y
13.5	4.5
16.25	11.75
1.75	7.75
3	1.5
10.5	7.75
10.25	17
10	4.5
19	11.75
4.5	11
12	2
22.5	1.5
10.25	12

S3M005C3 Boots	
X	Y
14.5	2
18.75	11
4	2.25
3.75	1.75
15.25	7.5
10.25	5
6.75	1.25
12	13.5
15.5	13.75
21.5	15.75
22	13.25
12	10.75

S4M006C3 Boots	
X	Y
1.75	6.75
5	1.5
5	4
1.75	4.25
1.75	11
5.25	11.5
5.25	6.5
4.75	14
1.75	14
5.25	9
1.5	1.5
2.5	16.5

S5F003C3 Boots	
X	Y
12	3.25
6.25	11
2.25	4.25
9.5	1.5
17.5	10.25
13.75	9.25
2	2.25
9.5	5.25
18.5	13
4.5	2.75
2.75	12.25
11.5	14.75

S5M008C1 Boots	
X	Y
16.25	1.75
13	5.5
2	1.75
9.25	2
20	1.75
18	16.25
21.25	16.25
16.5	5.75
12.5	2
19.5	5.5
5.5	3.5
17.75	13.5

Table 37. Continued

S2F001C2 Lamps	
X	Y
10	10.75
14.25	8.5
17.5	10.25
14.25	11.5
19	14
10.25	14.75
11	7.25
13	14.75
8.5	3.5
5.5	7
8.5	7.25
11.75	3.5

S2M003C3 Lamps	
X	Y
9.5	10.75
16.25	9
21	4.25
19.5	13.5
16.25	13.5
13	10.25
5	4.75
13.25	15
10.5	7.25
7.5	4.5
2	5
5.5	9.25

S4F002C1 Lamps	
X	Y
16	5.5
15.25	11.5
22.25	5
15.25	8.75
12	7.25
12	10.5
3.75	6
15.25	14.75
5.75	2.5
6.5	6.5
18.25	14.75
2.25	15

S5F003C1 Lamps	
X	Y
15.5	10.25
19.75	15.5
22.75	12
13.25	12.5
12	15.75
12	9
7.25	6
8	13.5
1.5	2.5
4	2
9.5	8.25
5	9

S5M008C2 Lamps	
X	Y
10.75	11.5
14	15.5
22.5	16
14.75	13.5
12	9
7.75	2.25
3.5	10
20	15.25
6.25	10.75
5.25	2
5.75	5.25
9.5	7.25

S6F004C3 Lamps	
X	Y
12.5	14.5
8	14.5
22.5	5.5
22.25	16.25
8	8.75
4.75	12
11.5	3
21.75	12.5
8.25	3
1.5	2
12.25	9.5
1.5	6.5

S2F001C3 Chairs	
X	Y
13.5	3.25
12.75	7
9.5	9.5
9.25	6
6.5	12
6.25	8.25
17.75	12.5
9.75	12.75
16.5	9.25
14	14
6.75	15.25
13	10.25

S2M003C1 Chairs	
X	Y
12	2.25
12.25	5
12	14.5
9	11.75
6	15.5
6.5	2.5
19	12.25
15.5	12.25
15.5	8.75
12	7.75
6.75	7
12	11.25

S3M004C2 Chairs	
X	Y
5.5	3.25
14.5	1
10.5	4.75
13.25	14.75
16.25	11.75
0.75	1.75
22.25	7
22.75	11
22.75	14.75
22.75	1.25
1.25	14.5
17.5	3.75

S4M006C2 Chairs	
X	Y
2.5	2
15.75	15
7	8.5
17.5	7
8.25	15.25
14.5	11.5
14	8
20.75	14.25
10	7.25
18	12.25
10.75	11.25
4.25	5.5

S5M007C2 Chairs	
X	Y
4.25	1.75
8.25	10
2	6
14.5	4
7.75	12.75
9.5	6.5
20.25	2.25
21.5	15.5
20.25	5.75
3.25	12.5
10.5	15
3.75	9.25

. Table 38. Category Averages for each Axis, with Axis Sums and Ranking.

	AVERAGES Spatulas							MAX		
	X	Y		XY SUM	NX	NY	XY NSUM	26.79688	Nscore	Nrank
A	7.1875	7.0625	A	14.25	5.989583	7.847222	13.83681	A	26.79688	J
B	7.71875	9.21875	B	16.9375	6.432292	10.24306	16.67535	B	24.94792	C
C	13.8125	12.09375	C	25.90625	11.51042	13.4375	24.94792	C	24.58333	E
D	11.0625	13.6875	D	24.75	9.21875	15.20833	24.42708	D	24.42708	D
E	14.875	10.96875	E	25.84375	12.39583	12.1875	24.58333	E	22.77778	F
F	16.375	8.21875	F	24.59375	13.64583	9.131944	22.77778	F	20.41667	G
G	10.625	10.40625	G	21.03125	8.854167	11.5625	20.41667	G	20.26476	AVERAGE
H	8.21875	9.5625	H	17.78125	6.848958	10.625	17.47396	H	19.47917	I
I	13.875	7.125	I	21	11.5625	7.916667	19.47917	I	17.47396	H
J	17.40625	11.0625	J	28.46875	14.50521	12.29167	26.79688	J	17.31771	K
K	9.65625	8.34375	K	18	8.046875	9.270833	17.31771	K	16.67535	B
L	10	5.5	L	15.5	8.333333	6.111111	14.44444	L	14.44444	L
	11.73438	9.4375		21.17188	9.778646	10.48611	20.26476		13.83681	A
	24	18			20	20	40			

	AVERAGES Cups									
	X	Y		XY SUM	NX	NY	XY NSUM	28.90625	Nscore	Nrank
A	15.65625	7.75	A	23.40625	13.04688	8.611111	21.65799	A	28.90625	C
B	13.375	6.9375	B	20.3125	11.14583	7.708333	18.85417	B	28.17708	J
C	16.8125	13.40625	C	30.21875	14.01042	14.89583	28.90625	C	22.88194	H
D	8.53125	7.25	D	15.78125	7.109375	8.055556	15.16493	D	22.17882	F
E	12.15625	8.84375	E	21	10.13021	9.826389	19.9566	E	21.65799	A
F	11.65625	11.21875	F	22.875	9.713542	12.46528	22.17882	F	20.21123	AVERAGE
G	3.71875	9.1875	G	12.90625	3.098958	10.20833	13.30729	G	19.9566	E
H	16.5	8.21875	H	24.71875	13.75	9.131944	22.88194	H	19.67014	K
I	10.28125	6.625	I	16.90625	8.567708	7.361111	15.92882	I	18.85417	B
J	17.4375	12.28125	J	29.71875	14.53125	13.64583	28.17708	J	15.92882	I
K	12.0625	8.65625	K	20.71875	10.05208	9.618056	19.67014	K	15.85069	L
L	6.0625	9.71875	L	15.78125	5.052083	10.79861	15.85069	L	15.16493	D
AVERAGE	12.02083	9.174479		21.19531	10.01736	10.19387	20.21123		13.30729	G

	AVERAGES Boots									
	X	Y		XY SUM	NX	NY	XY NSUM	23.93849	Nscore	Nrank
A	10.60714	5.107143	A	15.71429	8.839286	5.674603	14.51389	A	23.93849	L
B	11.25	9.214286	B	20.46429	9.375	10.2381	19.6131	B	23.04563	F
C	5.178571	7.107143	C	12.28571	4.315476	7.896825	12.2123	C	22.44048	H
D	6.428571	4.964286	D	11.39286	5.357143	5.515873	10.87302	D	19.98016	E
E	12.07143	8.928571	E	21	10.05952	9.920635	19.98016	E	19.6131	B
F	10.89286	12.57143	F	23.46429	9.077381	13.96825	23.04563	F	19.36508	I
G	10.60714	5.464286	G	16.07143	8.839286	6.071429	14.91071	G	18.09524	J
H	12.64286	10.71429	H	23.35714	10.53571	11.90476	22.44048	H	17.94229	AVERAGE
I	9.428571	10.35714	I	19.78571	7.857143	11.50794	19.36508	I	16.31944	K
J	12.14286	7.178571	J	19.32143	10.11905	7.97619	18.09524	J	14.91071	G
K	10.53571	6.785714	K	17.32143	8.779762	7.539683	16.31944	K	14.51389	A
L	11.82143	12.67857	L	24.5	9.85119	14.0873	23.93849	L	12.2123	C
	10.3006	8.422619		18.72321	8.583829	9.358466	17.94229		10.87302	D

	AVERAGES Lamps									
	X	Y		XY SUM	NX	NY	XY NSUM	28.55324	Nscore	Nrank
A	12.375	10.54167	A	22.91667	10.3125	11.71296	22.02546	A	28.55324	H
B	14.58333	12.41667	B	27	12.15278	13.7963	25.94907	B	27.8588	D
C	21.41667	8.833333	C	30.25	17.84722	9.814815	27.66204	C	27.66204	C
D	16.54167	12.66667	D	29.20833	13.78472	14.07407	27.8588	D	25.94907	B
E	13.20833	11.375	E	24.58333	11.00694	12.63889	23.64583	E	23.64583	E
F	9.958333	9.791667	F	19.75	8.298611	10.87963	19.17824	F	22.02546	A
G	7	6.166667	G	13.16667	5.833333	6.851852	12.68519	G	19.89005	AVERAGE
H	15.20833	14.29167	H	29.5	12.67361	15.87963	28.55324	H	19.17824	F
I	6.791667	4.916667	I	11.70833	5.659722	5.462963	11.12269	I	17.07176	K
J	5.041667	4	J	9.041667	4.201389	4.444444	8.645833	J	14.28241	L
K	9.375	8.333333	K	17.70833	7.8125	9.259259	17.07176	K	12.68519	G
L	5.916667	8.416667	L	14.33333	4.930556	9.351852	14.28241	L	11.12269	I
	11.45139	9.3125		20.76389	9.542824	10.34722	19.89005		8.645833	J

	AVERAGES Chairs									
	X	Y		XY SUM	NX	NY	XY NSUM	29.65278	Nscore	Nrank
A	7.55	2.5	A	10.05	6.291667	2.777778	9.069444	A	29.65278	H
B	12.7	7.6	B	20.3	10.58333	8.444444	19.02778	B	24.875	G
C	8.2	8.65	C	16.85	6.833333	9.611111	16.44444	C	24.33333	I
D	12.7	8.7	D	21.4	10.58333	9.666667	20.25	D	22.40278	E
E	8.95	13.45	E	22.4	7.458333	14.94444	22.40278	E	22.27778	J
F	7.5	6.1	F	13.6	6.25	6.777778	13.02778	F	20.25	D
G	18.65	8.4	G	27.05	15.54167	9.333333	24.875	G	20	K
H	18.05	13.15	H	31.2	15.04167	14.61111	29.65278	H	19.88889	AVERAGE
I	17	9.15	I	26.15	14.16667	10.16667	24.33333	I	19.02778	B
J	14	9.55	J	23.55	11.66667	10.61111	22.27778	J	17.30556	L
K	7.2	12.6	K	19.8	6	14	20	K	16.44444	C
L	10.1	8	L	18.1	8.416667	8.888889	17.30556	L	13.02778	F
	11.88333	8.9875		20.87083	9.902778	9.986111	19.88889		9.069444	A

Table 39. Normalized Scores and Normalized Ranking Spreadsheets.

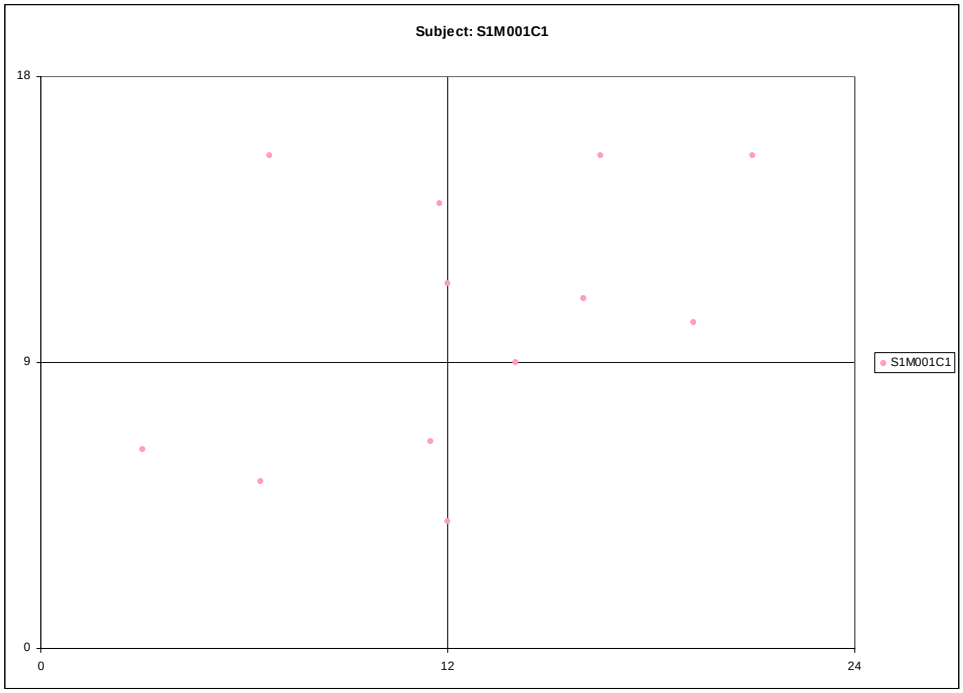
	X	Y					
STD DEV:	3.44618	2.340926					
MEAN:	11.73438	9.4375	NSUM				
					NX	NY	NSUM
A	-1.3194	-1.01456	-2.33395	J	1.645844	0.69417	2.340014
B	-1.16524	-0.09345	-1.25869	C	0.603023	1.1347	1.737723
C	0.603023	1.1347	1.737723	D	-0.19496	1.815521	1.620558
D	-0.19496	1.815521	1.620558	E	0.911335	0.654121	1.565457
E	0.911335	0.654121	1.565457	F	1.3466	-0.52063	0.825973
F	1.3466	-0.52063	0.825973	G	-0.32191	0.413832	0.091917
G	-0.32191	0.413832	0.091917	I	0.621159	-0.98786	-0.3667
H	-1.02015	0.053398	-0.96675	H	-1.02015	0.053398	-0.96675
I	0.621159	-0.98786	-0.3667	K	-0.60302	-0.46723	-1.07025
J	1.645844	0.69417	2.340014	B	-1.16524	-0.09345	-1.25869
K	-0.60302	-0.46723	-1.07025	L	-0.50327	-1.68203	-2.1853
L	-0.50327	-1.68203	-2.1853	A	-1.3194	-1.01456	-2.33395

	X	Y					
STD DEV:	4.340046	2.143985					
MEAN:	12.02083	9.174479	NSUM				
					NX	NY	NSUM
A	0.837645	-0.66441	0.173238	C	1.104059	1.973787	3.077846
B	0.312017	-1.04337	-0.73136	J	1.248067	1.449064	2.69713
C	1.104059	1.973787	3.077846	F	-0.084	0.953491	0.869487
D	-0.80404	-0.89762	-1.70166	H	1.032055	-0.44577	0.586283
E	0.031202	-0.15426	-0.12306	A	0.837645	-0.66441	0.173238
F	-0.084	0.953491	0.869487	E	0.031202	-0.15426	-0.12306
G	-1.9129	0.006073	-1.90683	K	0.009601	-0.24171	-0.23211
H	1.032055	-0.44577	0.586283	B	0.312017	-1.04337	-0.73136
I	-0.40082	-1.18913	-1.58995	L	-1.37287	0.253859	-1.11901
J	1.248067	1.449064	2.69713	I	-0.40082	-1.18913	-1.58995
K	0.009601	-0.24171	-0.23211	D	-0.80404	-0.89762	-1.70166
L	-1.37287	0.253859	-1.11901	G	-1.9129	0.006073	-1.90683

	X	Y					
STD DEV:	2.292525	2.744654					
MEAN:	10.3006	8.422619	NSUM				
					NX	NY	NSUM
A	0.133716	-1.20798	-1.07426	L	0.663388	1.550634	2.214021
B	0.414131	0.28844	0.70257	H	1.021695	0.834957	1.856652
C	-2.23423	-0.47929	-2.71351	F	0.258345	1.511597	1.769941
D	-1.68898	-1.26003	-2.949	E	0.772438	0.184341	0.956779
E	0.772438	0.184341	0.956779	B	0.414131	0.28844	0.70257
F	0.258345	1.511597	1.769941	J	0.803595	-0.45326	0.350333
G	0.133716	-1.07785	-0.94414	I	-0.38038	0.704833	0.324456
H	1.021695	0.834957	1.856652	K	0.102559	-0.5964	-0.49384
I	-0.38038	0.704833	0.324456	G	0.133716	-1.07785	-0.94414
J	0.803595	-0.45326	0.350333	A	0.133716	-1.20798	-1.07426
K	0.102559	-0.5964	-0.49384	C	-2.23423	-0.47929	-2.71351
L	0.663388	1.550634	2.214021	D	-1.68898	-1.26003	-2.949

	X	Y					
STD DEV:	4.980576	3.178134					
MEAN:	11.45139	9.3125	NSUM				
					NX	NY	NSUM
A	0.185443	0.386757	0.5722	H	0.754319	1.566695	2.321014
B	0.628832	0.976726	1.605558	D	1.022026	1.055389	2.077415
C	2.000828	-0.15077	1.850059	C	2.000828	-0.15077	1.850059
D	1.022026	1.055389	2.077415	B	0.628832	0.976726	1.605558
E	0.352759	0.648966	1.001725	E	0.352759	0.648966	1.001725
F	-0.29978	0.15077	-0.14901	A	0.185443	0.386757	0.5722
G	-0.89375	-0.98984	-1.88359	F	-0.29978	0.15077	-0.14901
H	0.754319	1.566695	2.321014	K	-0.4169	-0.30809	-0.72499
I	-0.93558	-1.38315	-2.31873	L	-1.11126	-0.28187	-1.39314
J	-1.28694	-1.67158	-2.95852	G	-0.89375	-0.98984	-1.88359
K	-0.4169	-0.30809	-0.72499	I	-0.93558	-1.38315	-2.31873
L	-1.11126	-0.28187	-1.39314	J	-1.28694	-1.67158	-2.95852

	X	Y					
STD DEV:	4.275583	3.082216					
MEAN:	11.88333	8.9875	NSUM				
					NX	NY	NSUM
A	-1.01351	-2.10482	-3.11832	H	1.442299	1.350489	2.792788
B	0.191007	-0.45016	-0.25916	G	1.58263	-0.19061	1.392021
C	-0.86148	-0.1095	-0.97098	I	1.196718	0.052722	1.24944
D	0.191007	-0.09328	0.09773	E	-0.68607	1.447822	0.761755
E	-0.68607	1.447822	0.761755	J	0.495059	0.182499	0.677558
F	-1.0252	-0.93683	-1.96203	D	0.191007	-0.09328	0.09773
G	1.58263	-0.19061	1.392021	K	-1.09537	1.172046	0.076679
H	1.442299	1.350489	2.792788	B	0.191007	-0.45016	-0.25916
I	1.196718	0.052722	1.24944	L	-0.4171	-0.32039	-0.73748
J	0.495059	0.182499	0.677558	C	-0.86148	-0.1095	-0.97098
K	-1.09537	1.172046	0.076679	F	-1.0252	-0.93683	-1.96203
L	-0.4171	-0.32039	-0.73748	A	-1.01351	-2.10482	-3.11832



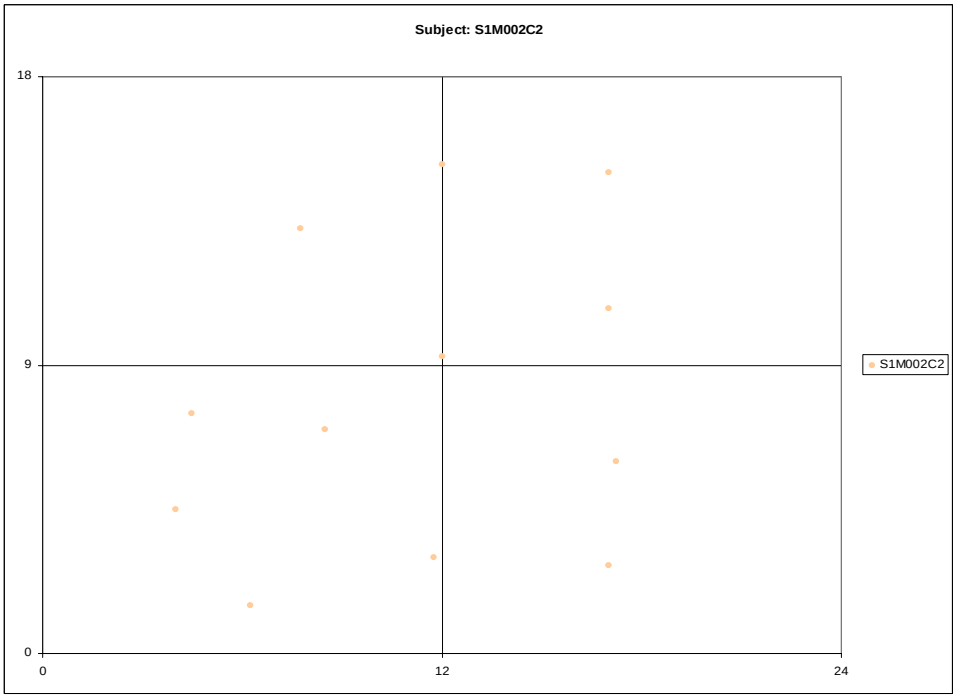
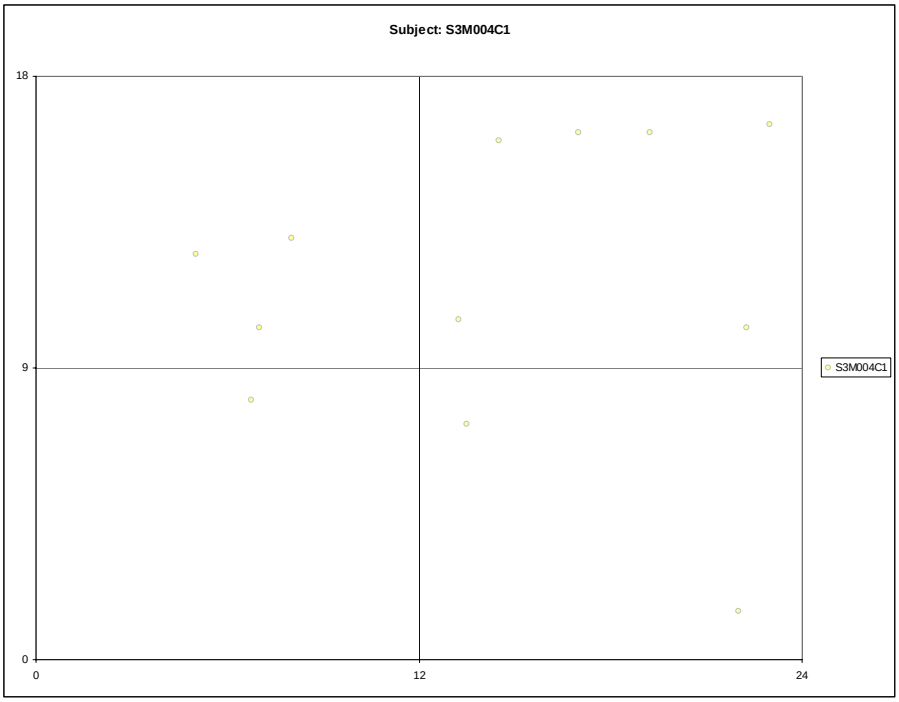


Figure 36. Spatula Category Ranking by Subject.



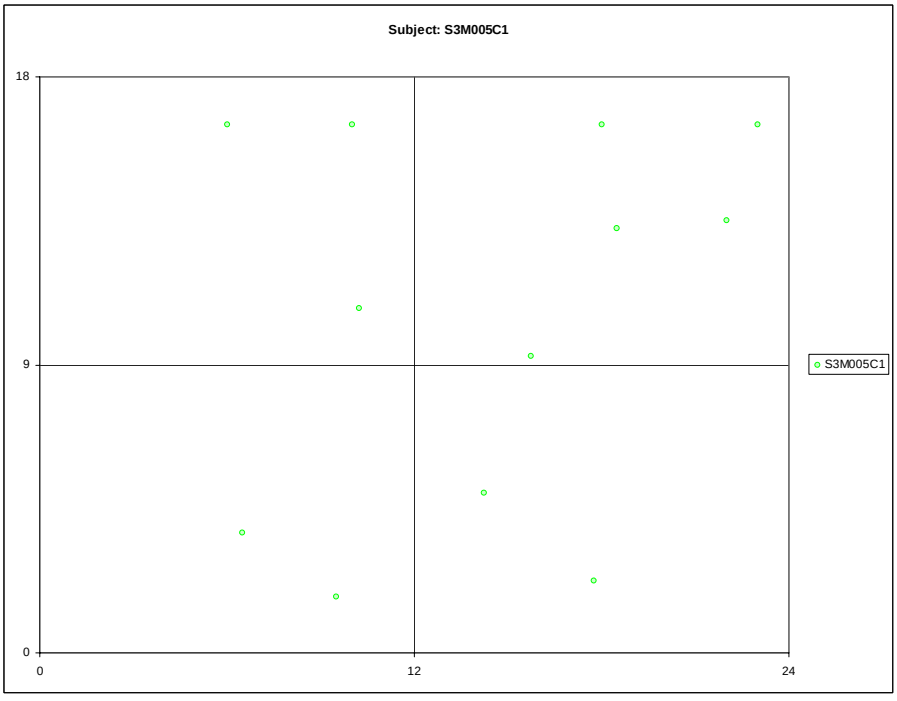


Figure 36. Continued

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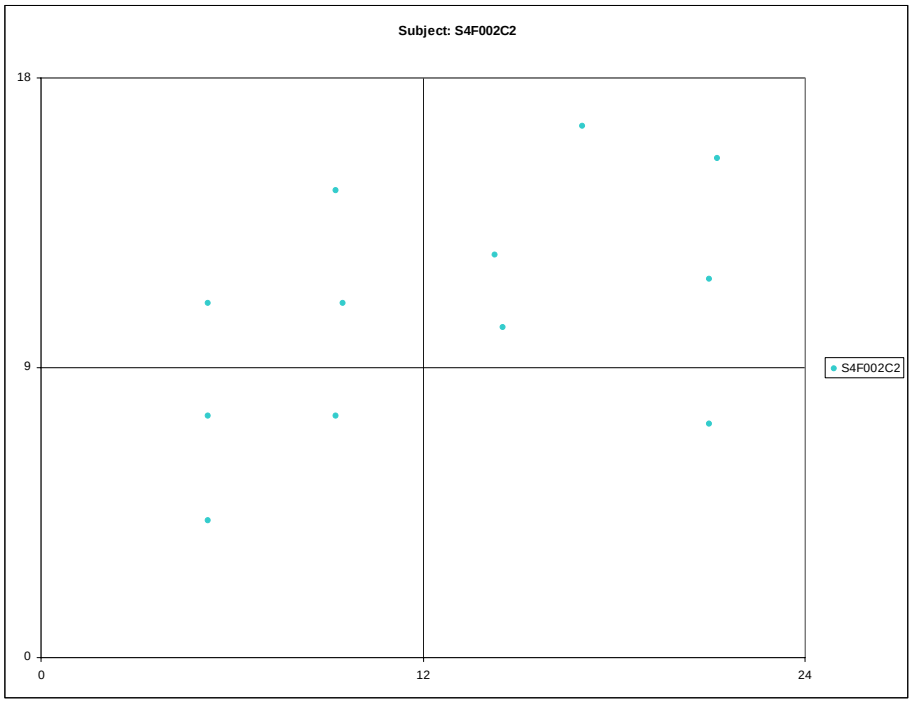


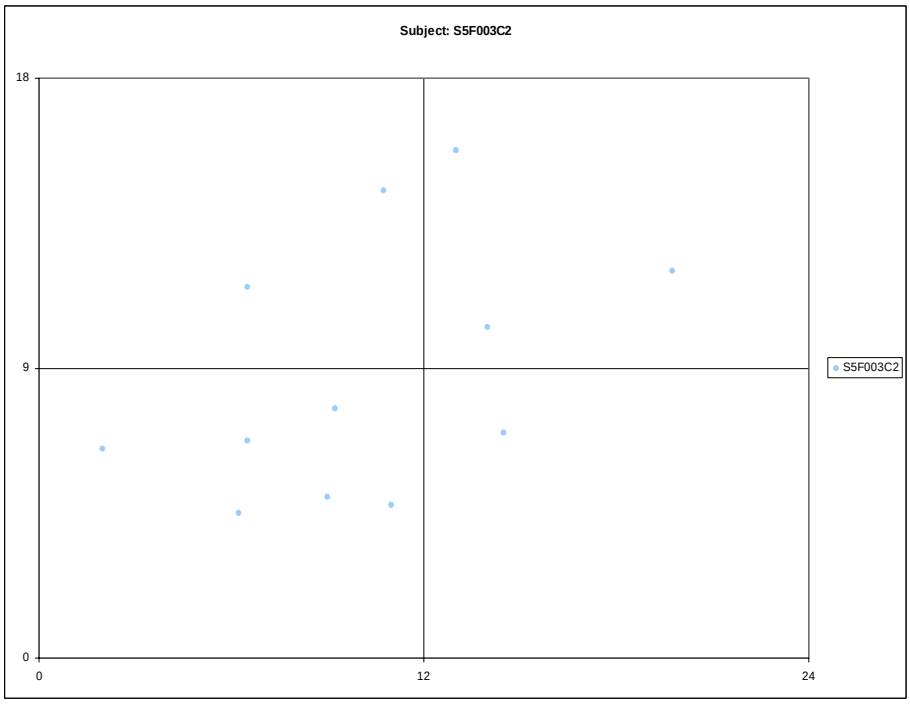
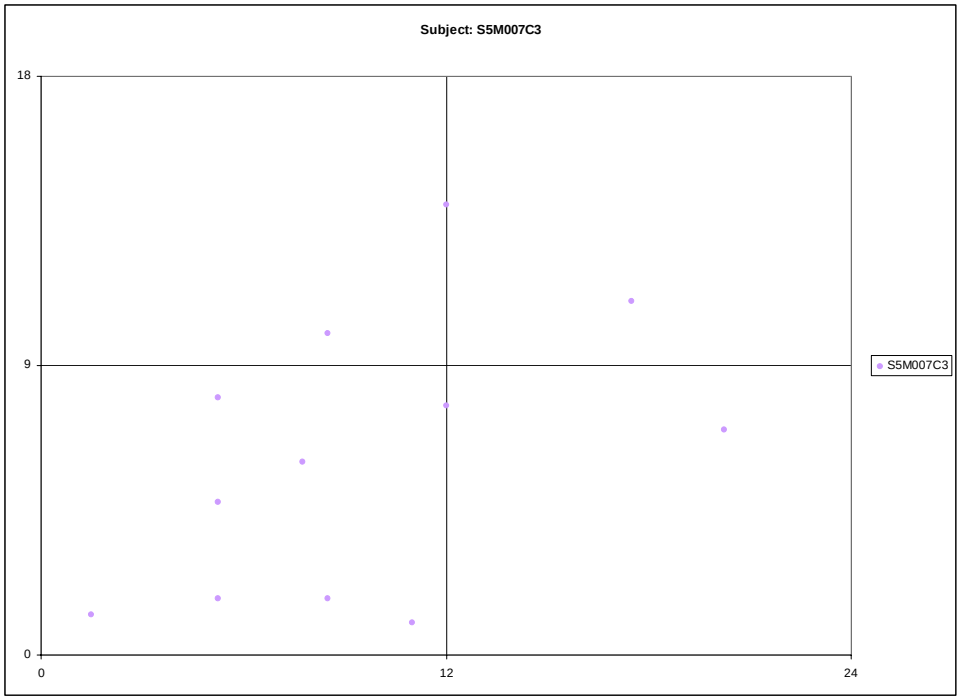


Figure 36. Continued



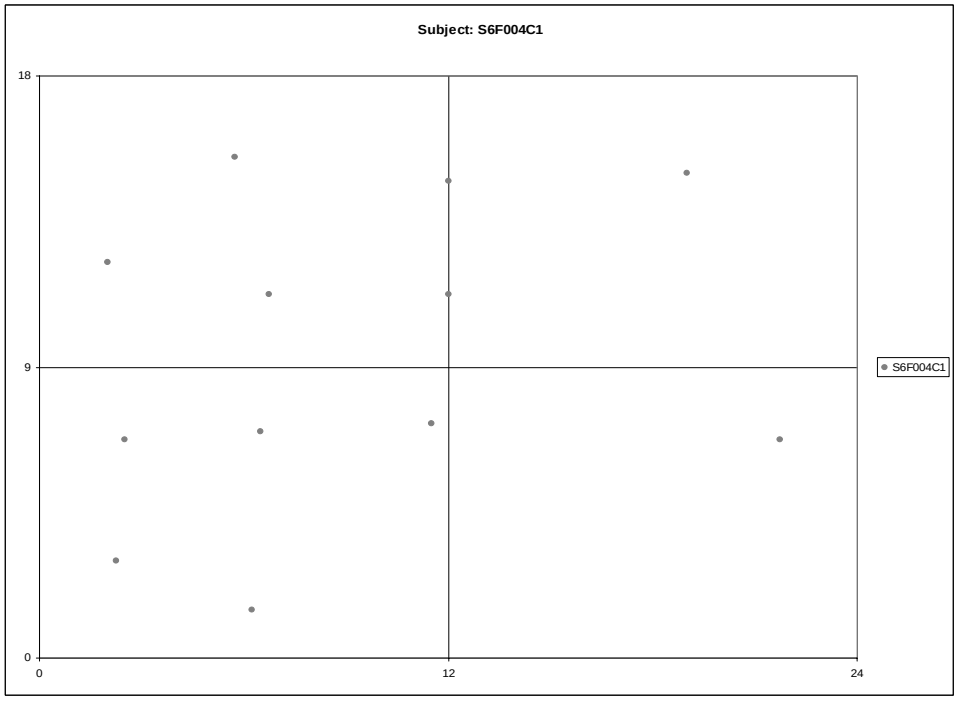
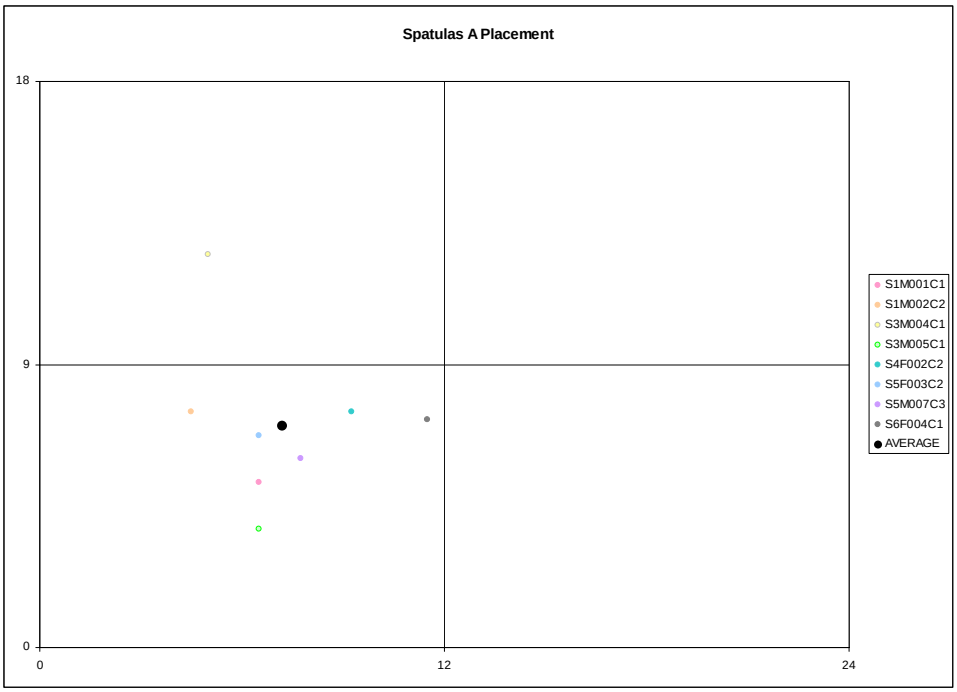


Figure 36. Continued



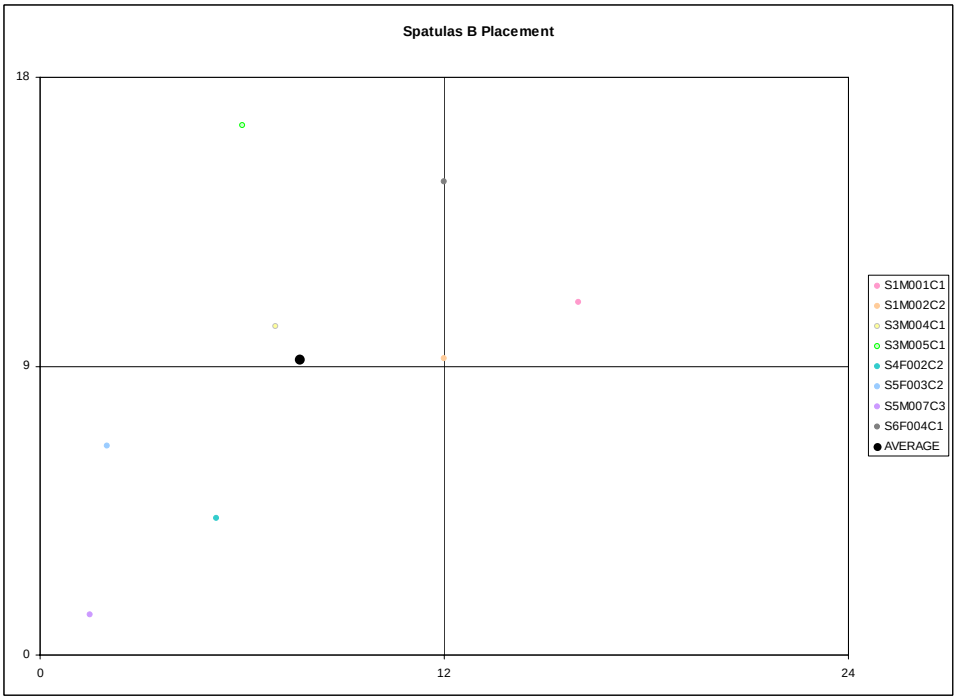
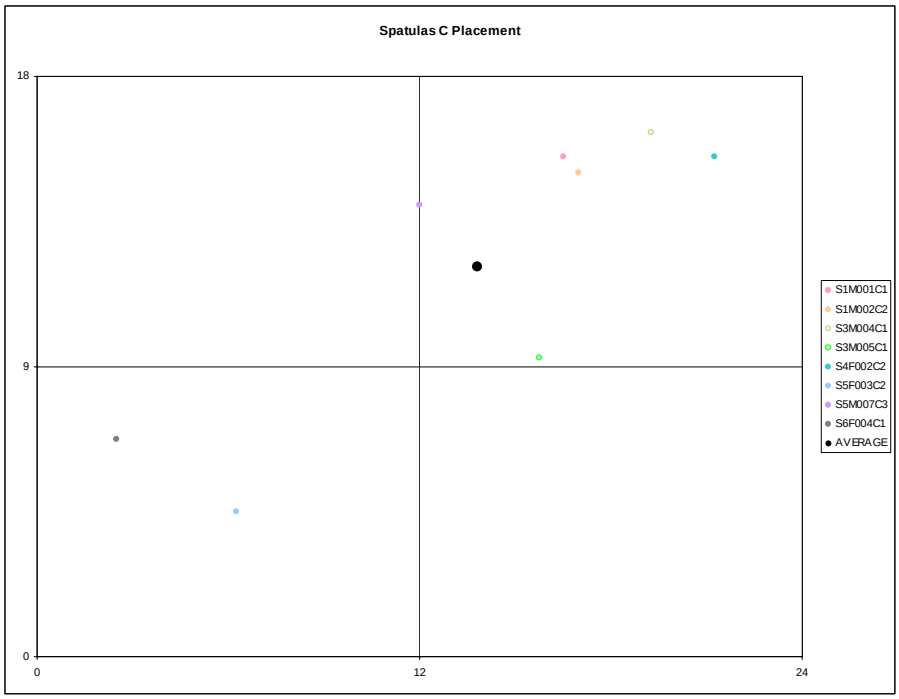


Figure 37. Spatula Product Placement By Product, with Product Average.



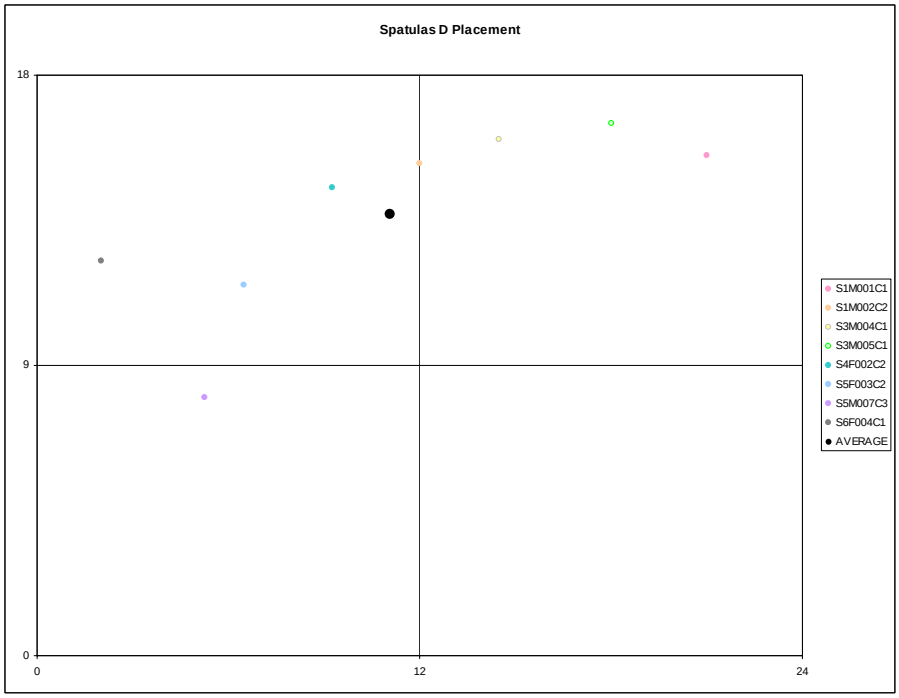
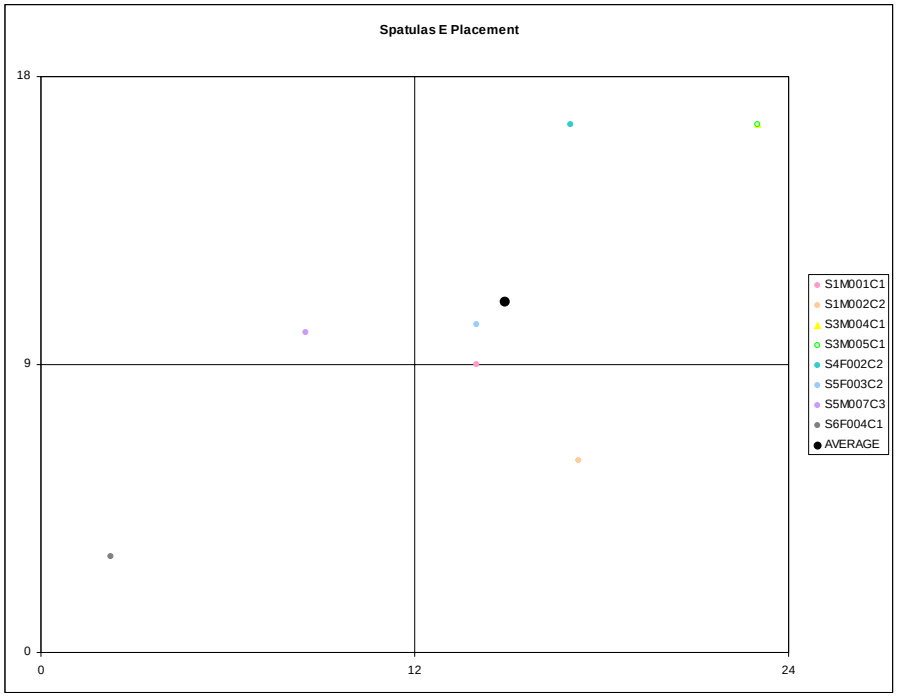


Figure 37. Continued



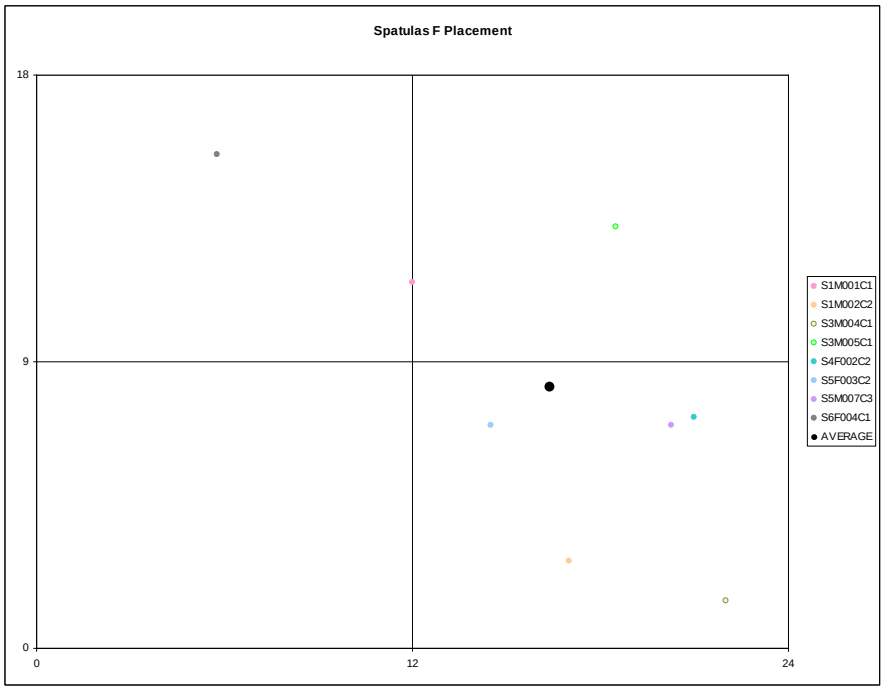
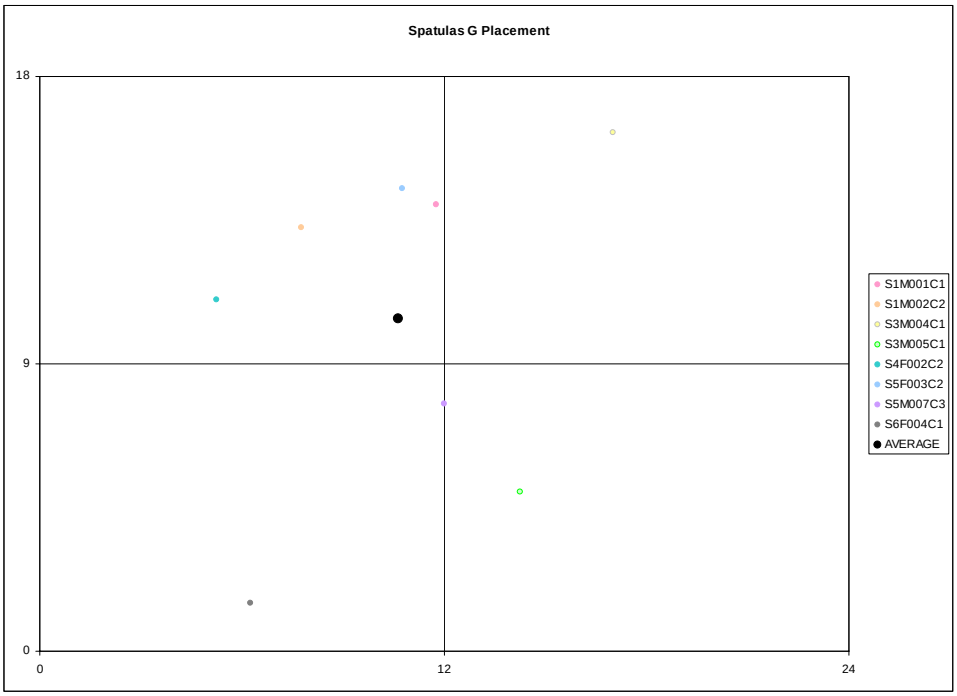


Figure 37. Continued



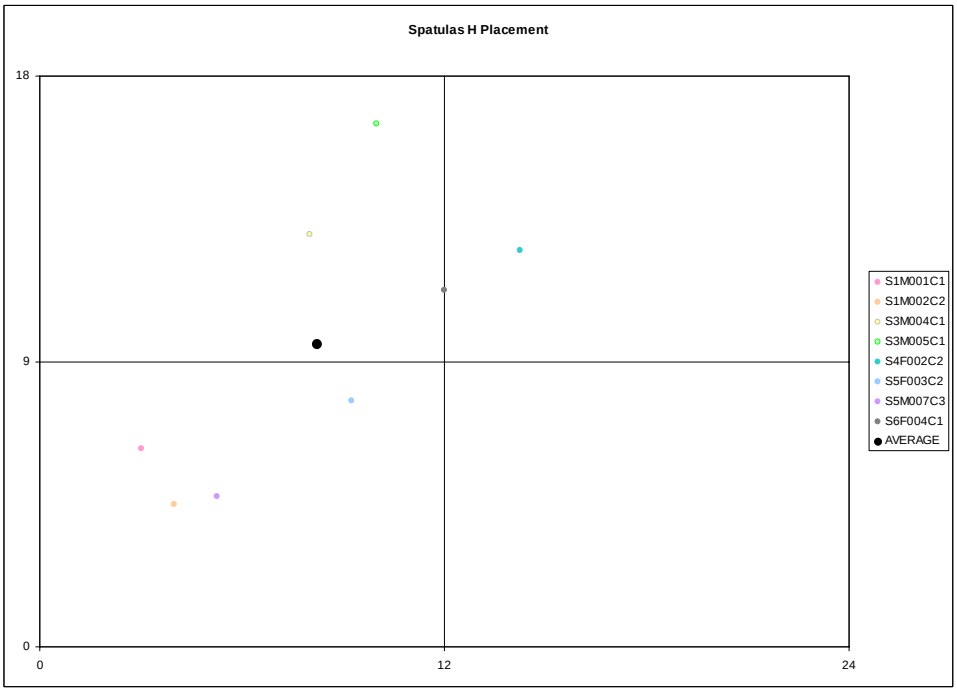
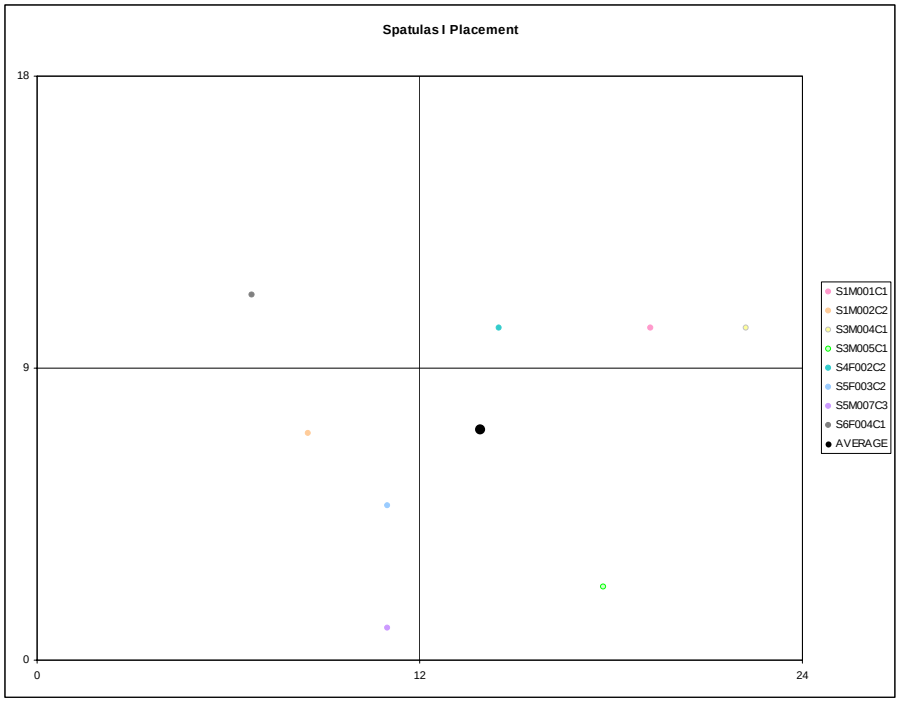


Figure 37. Continued



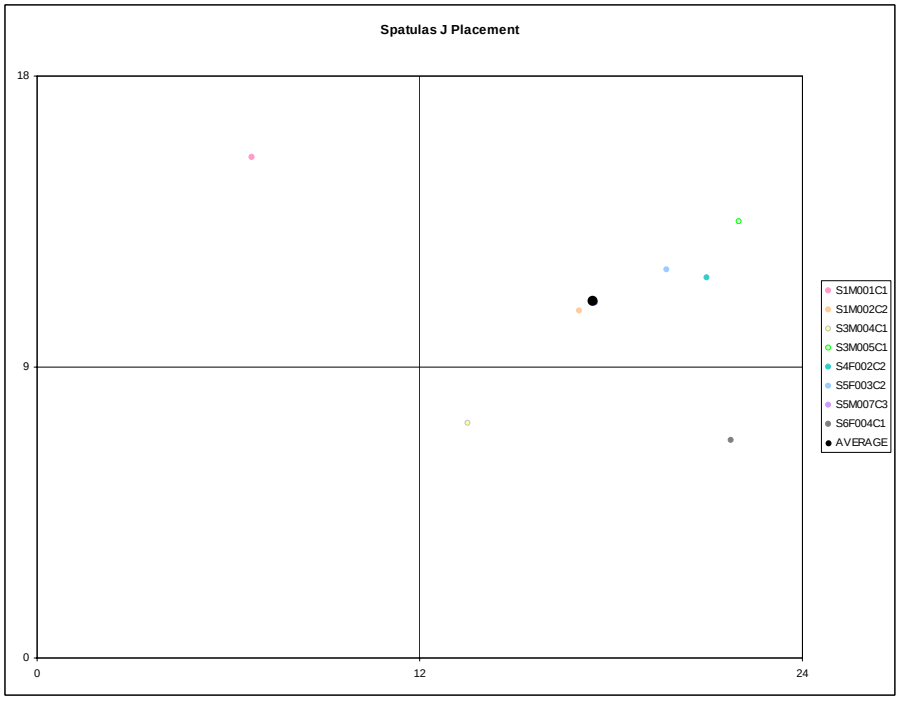
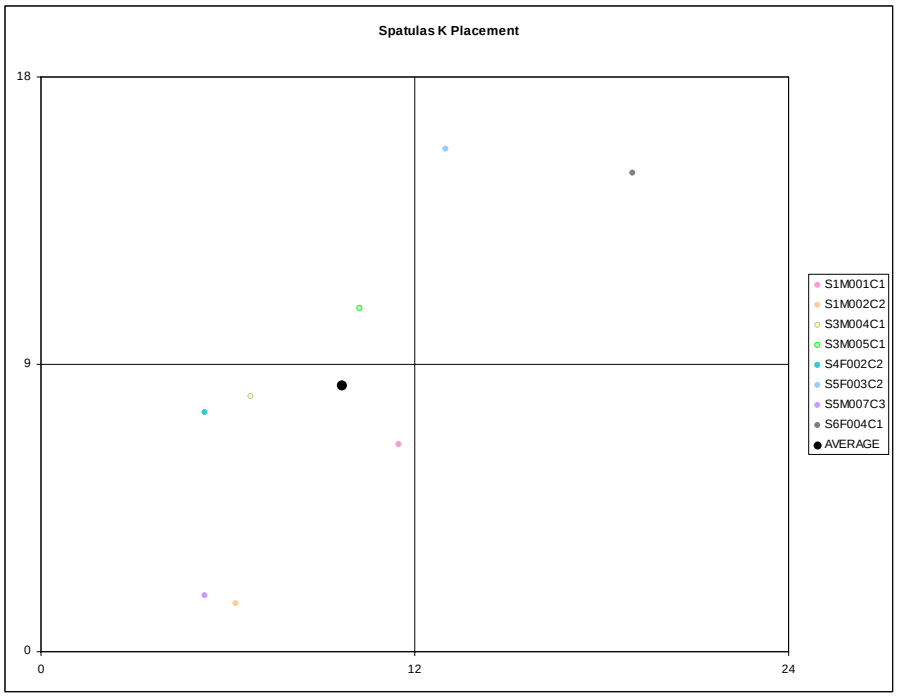


Figure 37. Continued



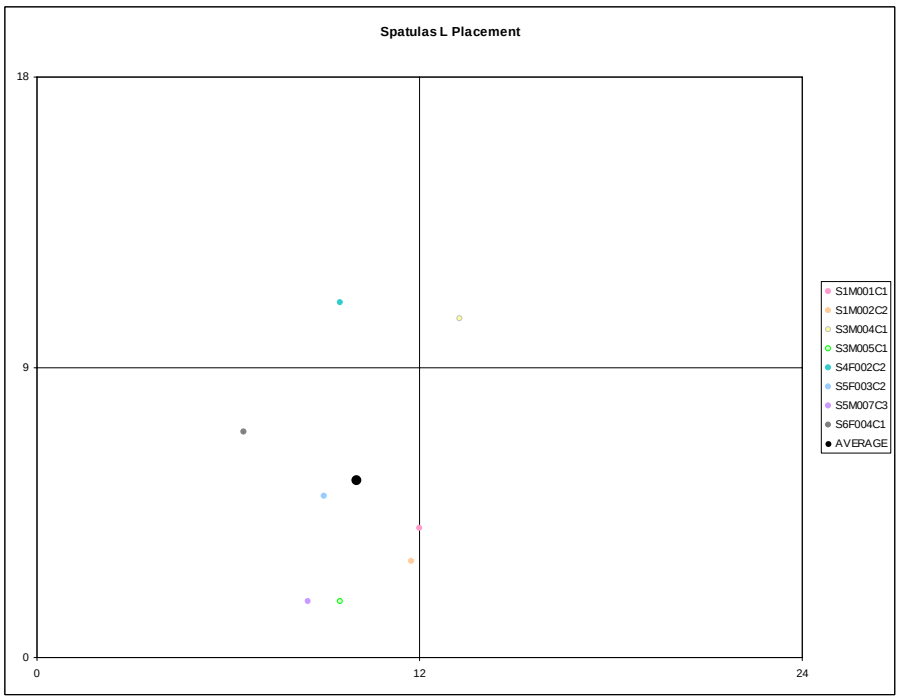
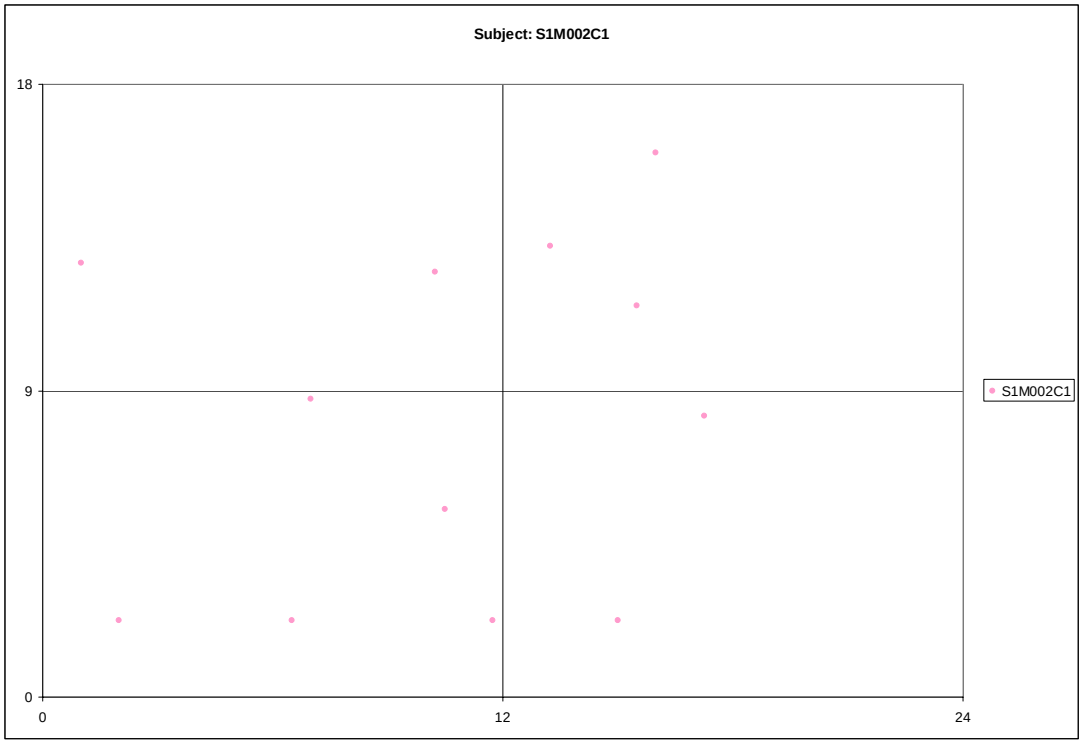


Figure 37. Continued

Table 40. Spatulas Ranked by Normalized Score.

Spatula		Frequency
J		2.340014
C		1.737723
D		1.620558
E		1.565457
F		0.825973
G		0.091917
I		-0.3667
H		-0.96675
K		-1.07025
B		-1.25869
L		-2.1853
A		-2.33395



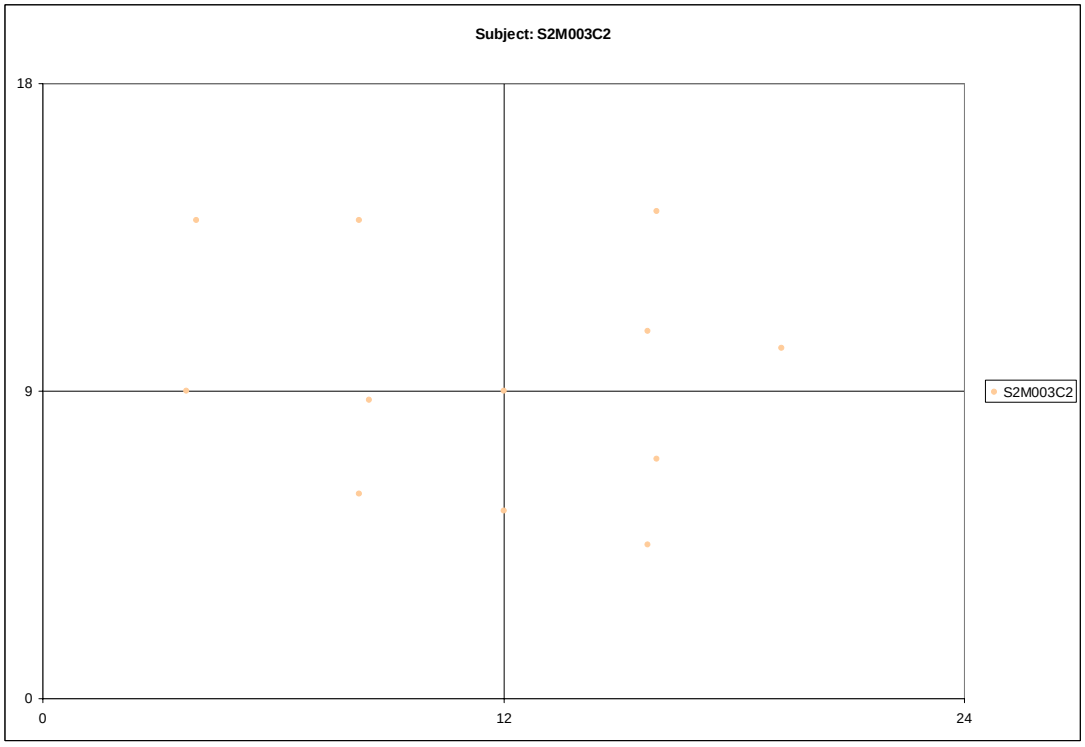
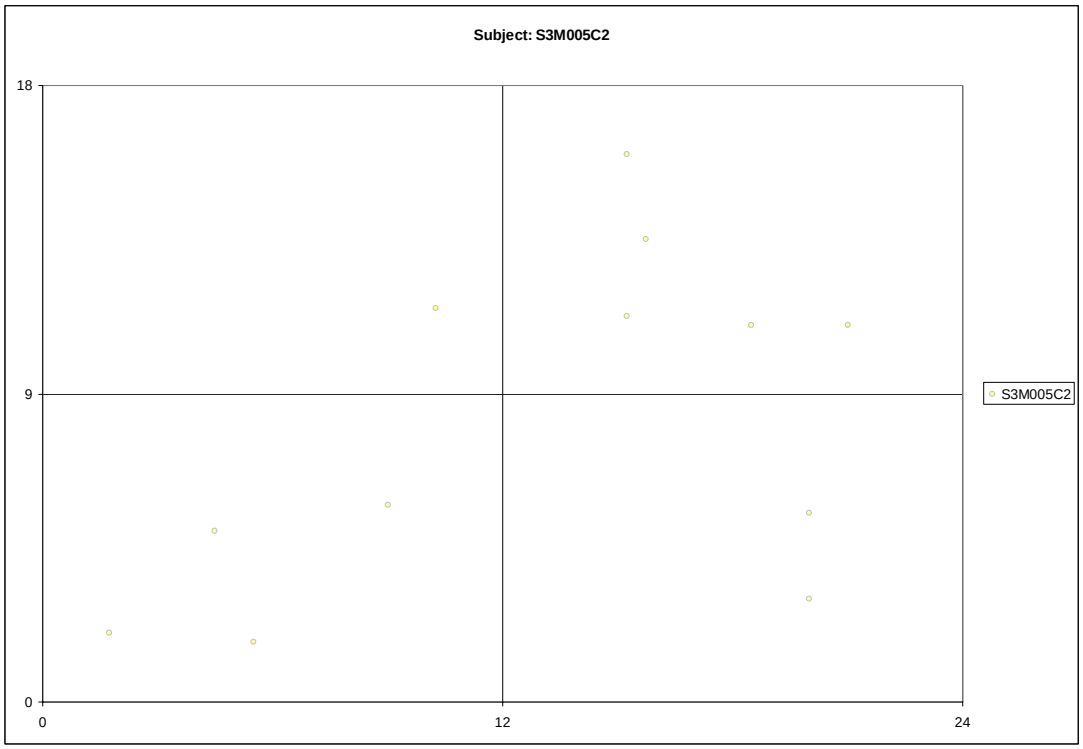


Figure 38. Mug Category Ranking By Subject.



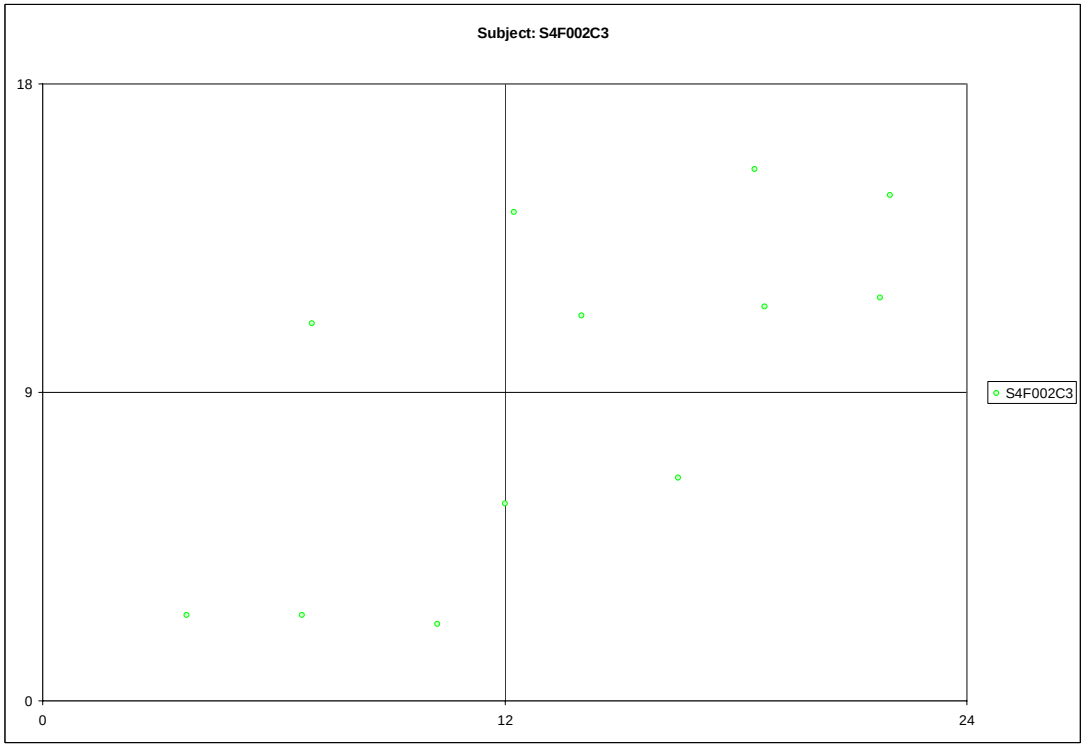
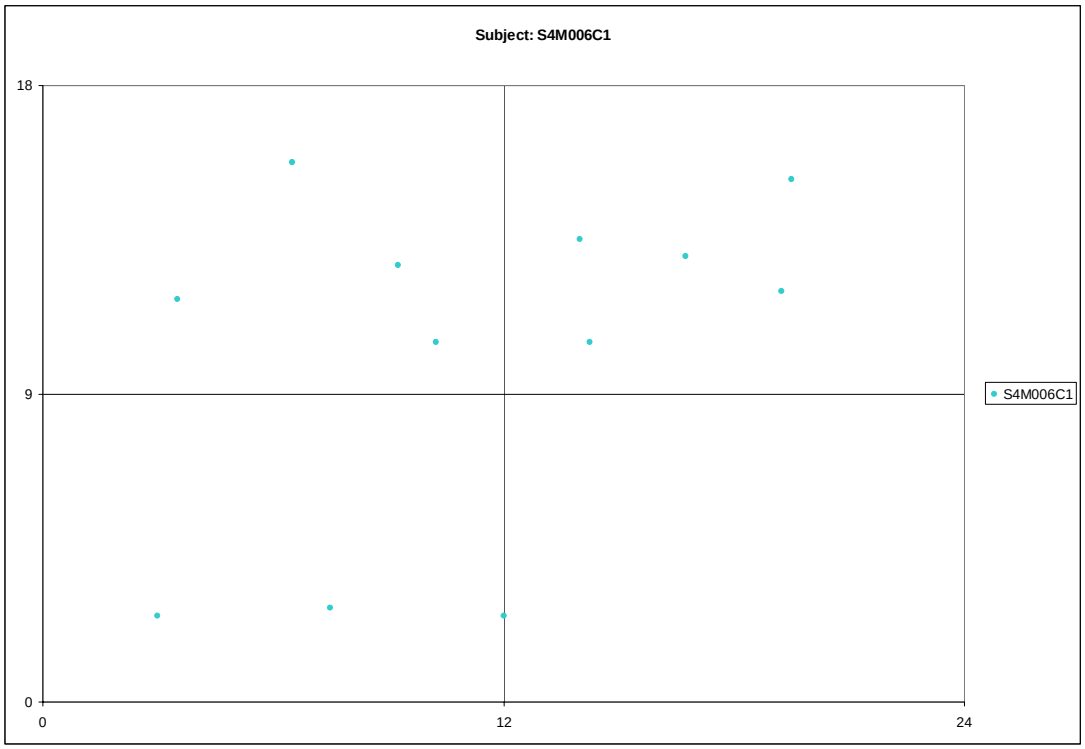


Figure 38 Continued.



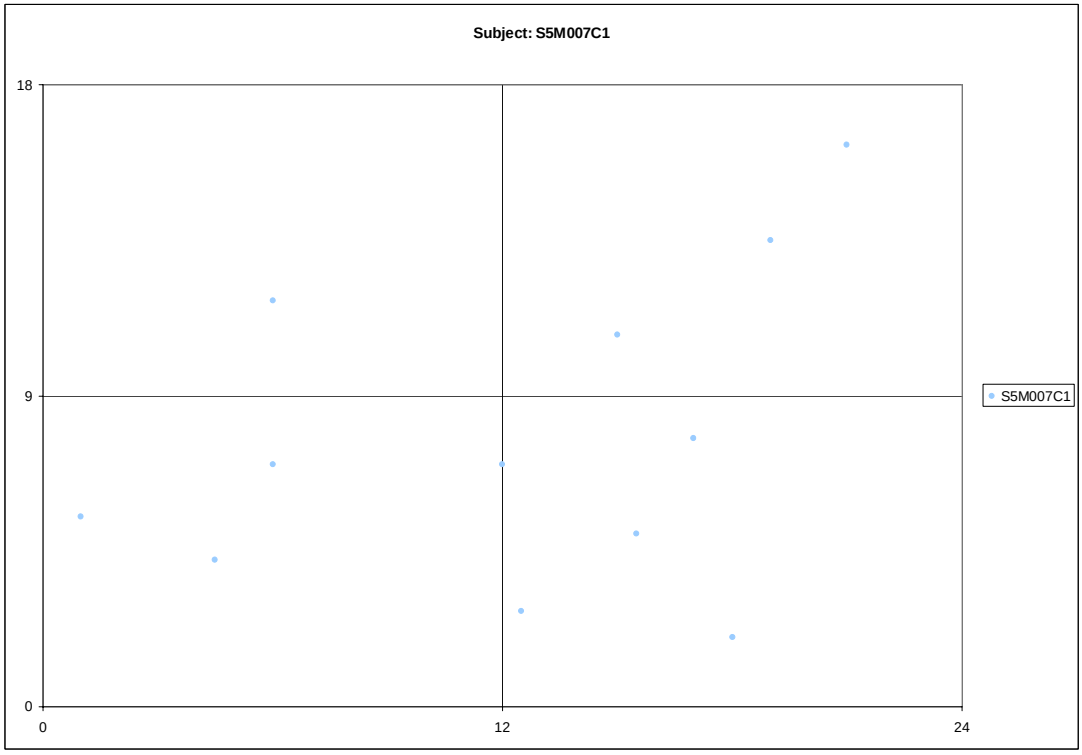
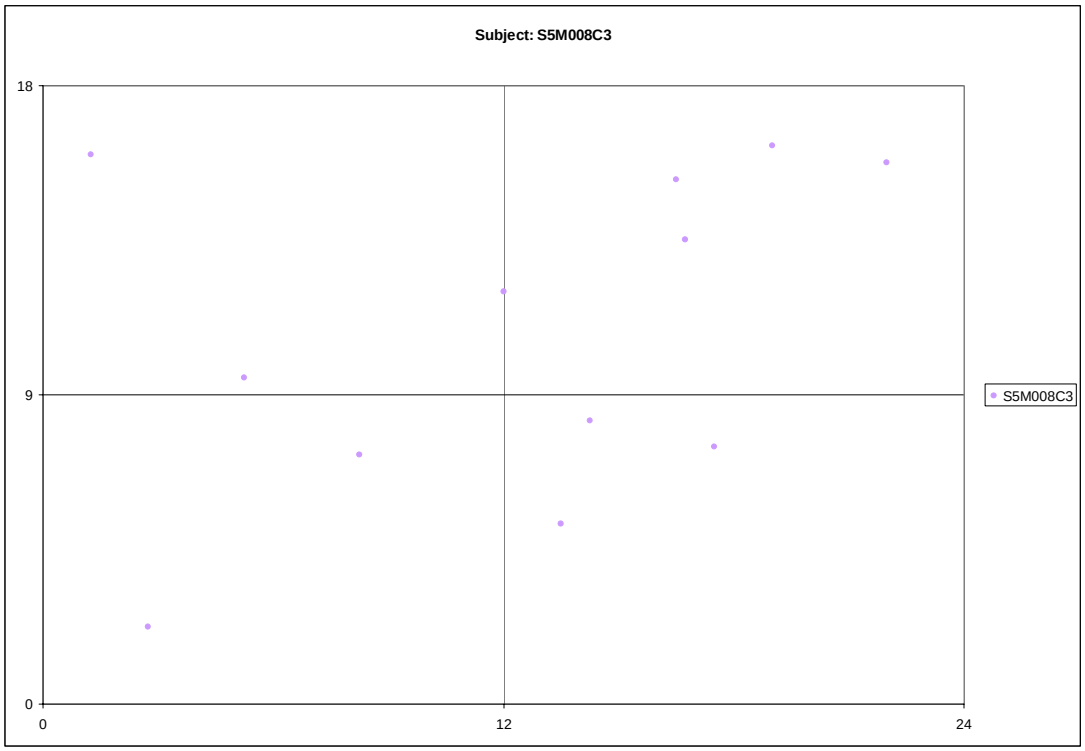


Figure 38. Continued.



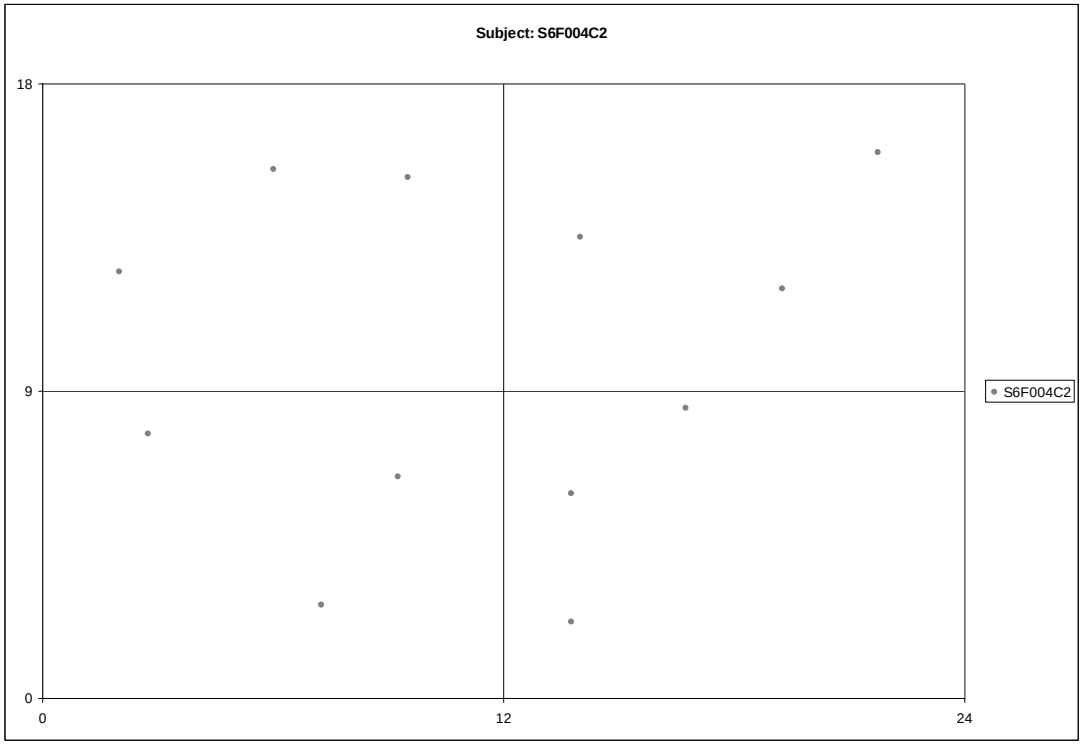
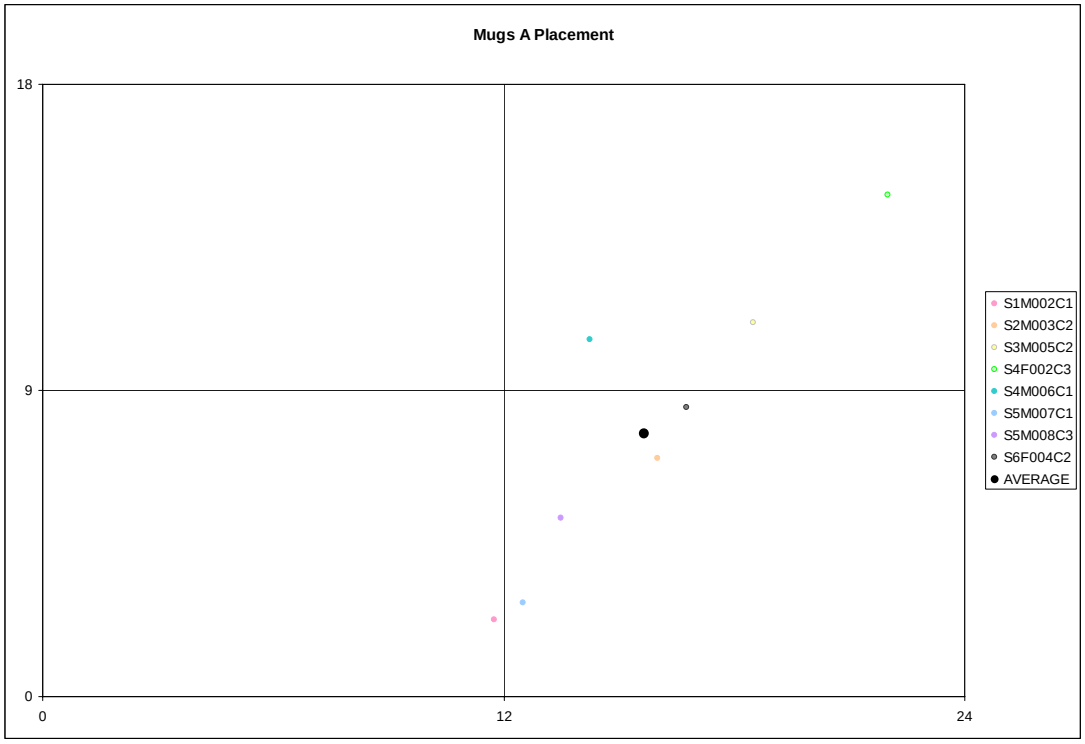


Figure 38. Continued.



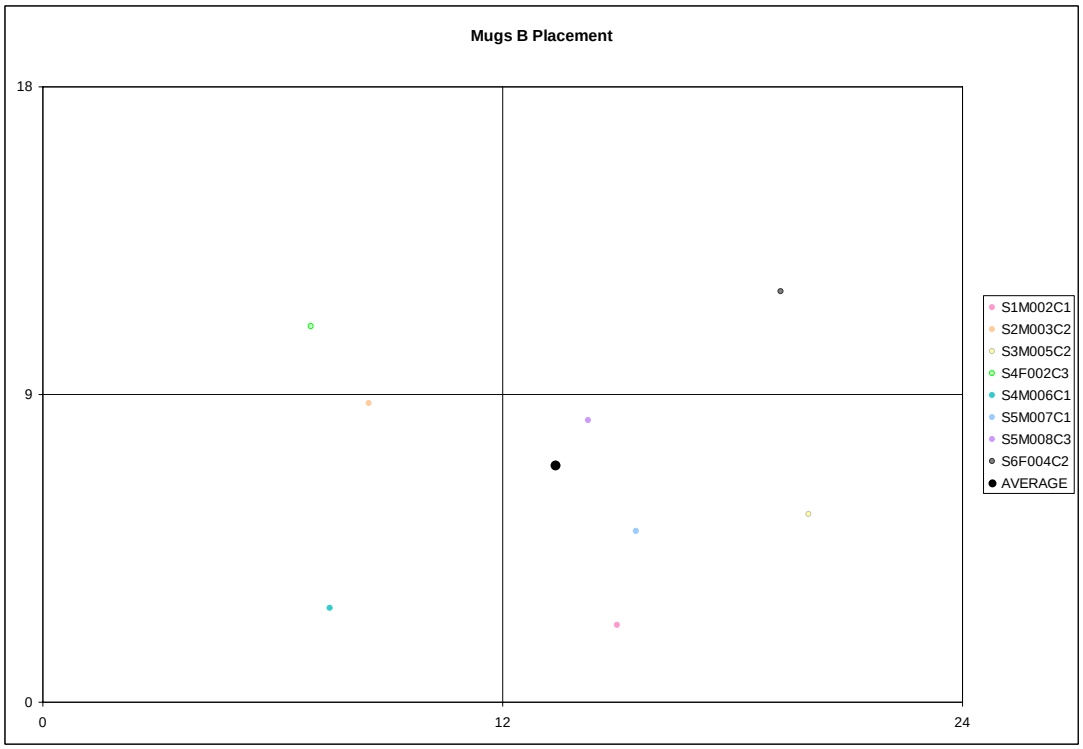
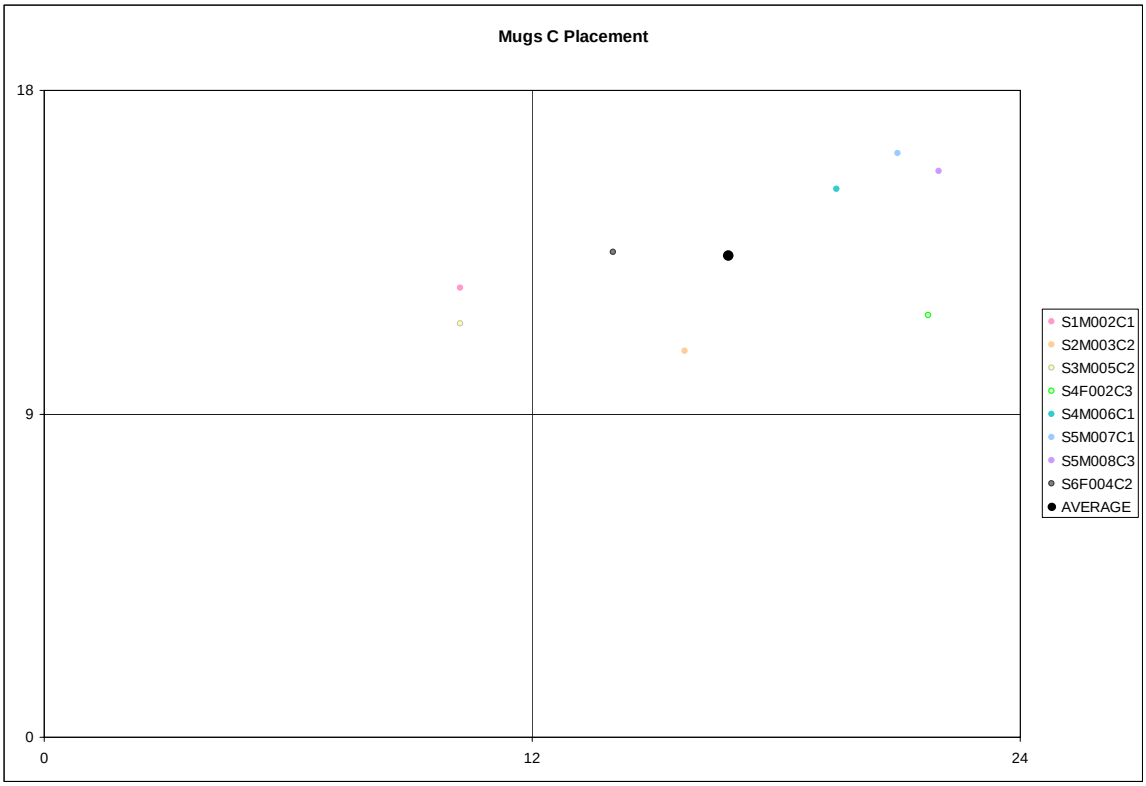


Figure 39. Mug Product Placement By Product, with Product Average.

.



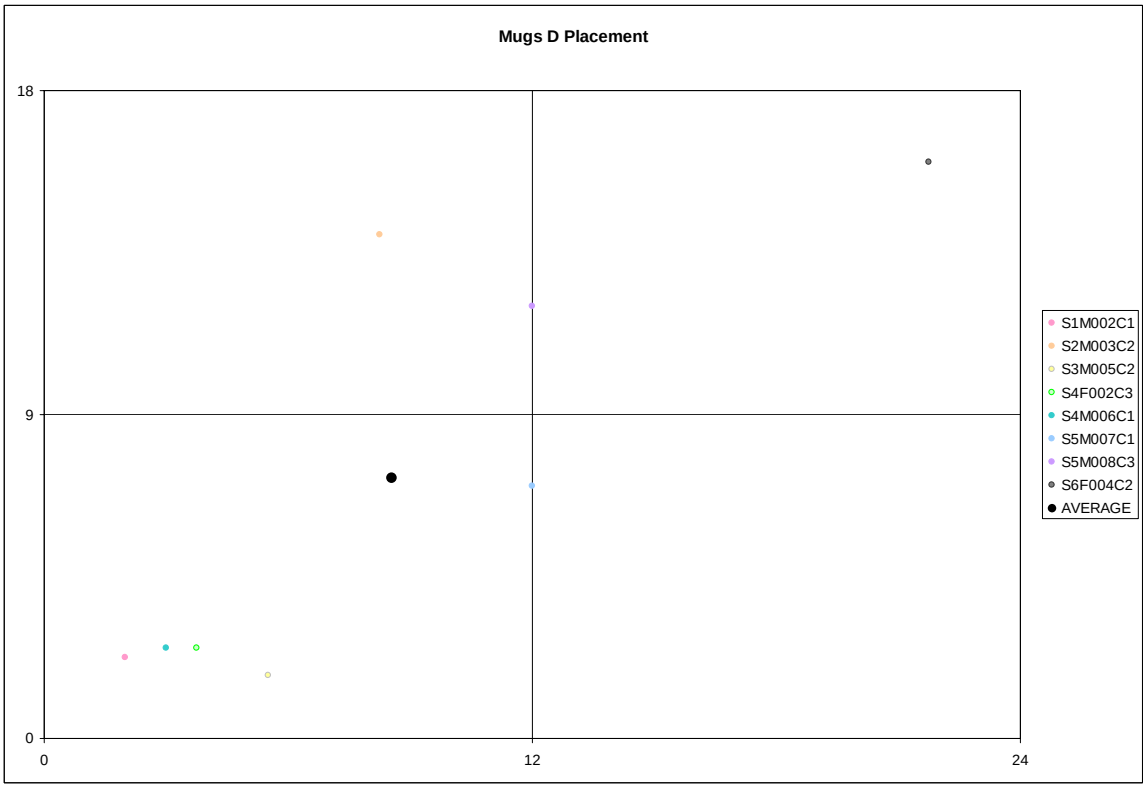
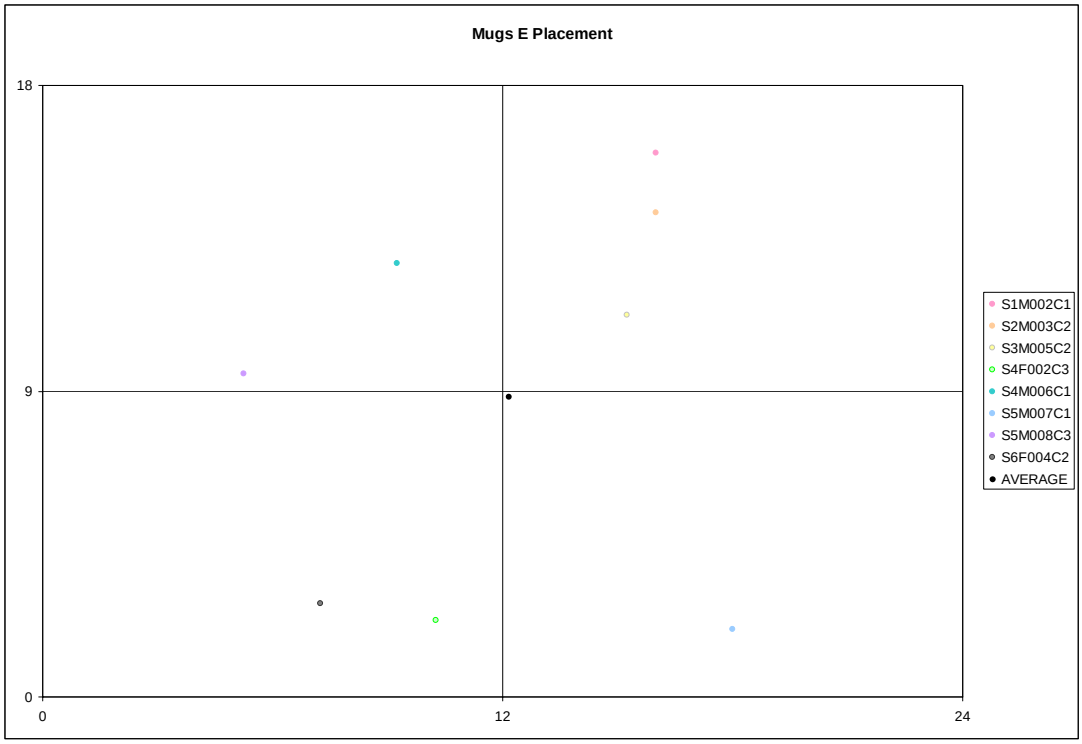


Figure 39. Continued.



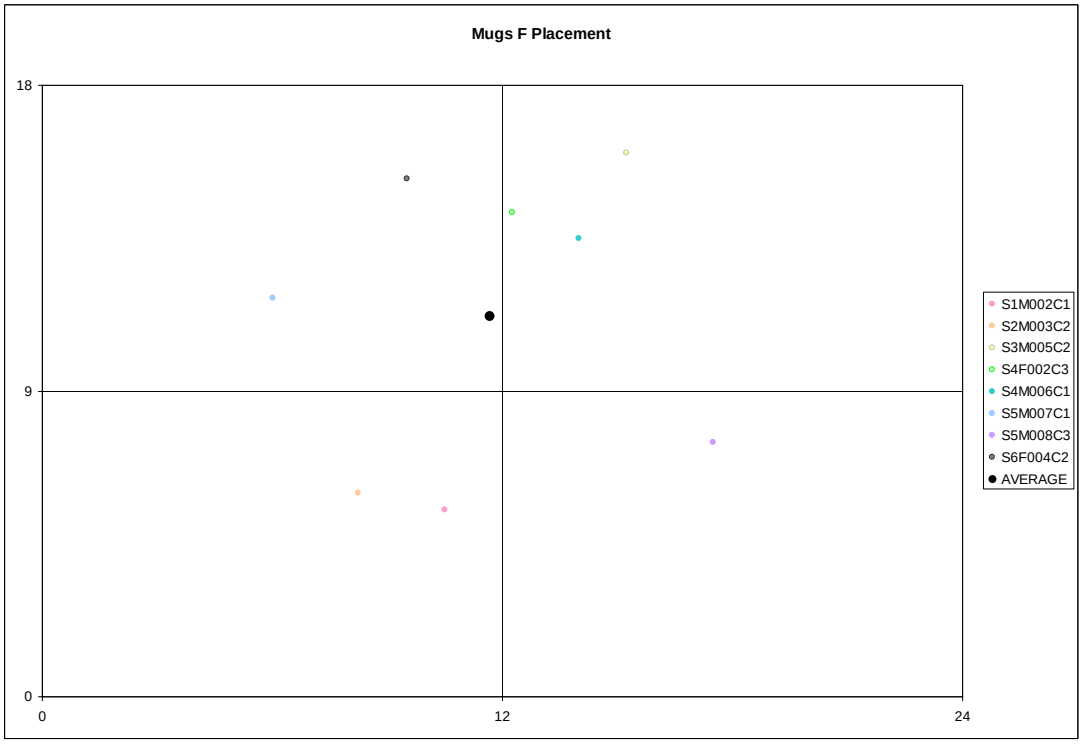
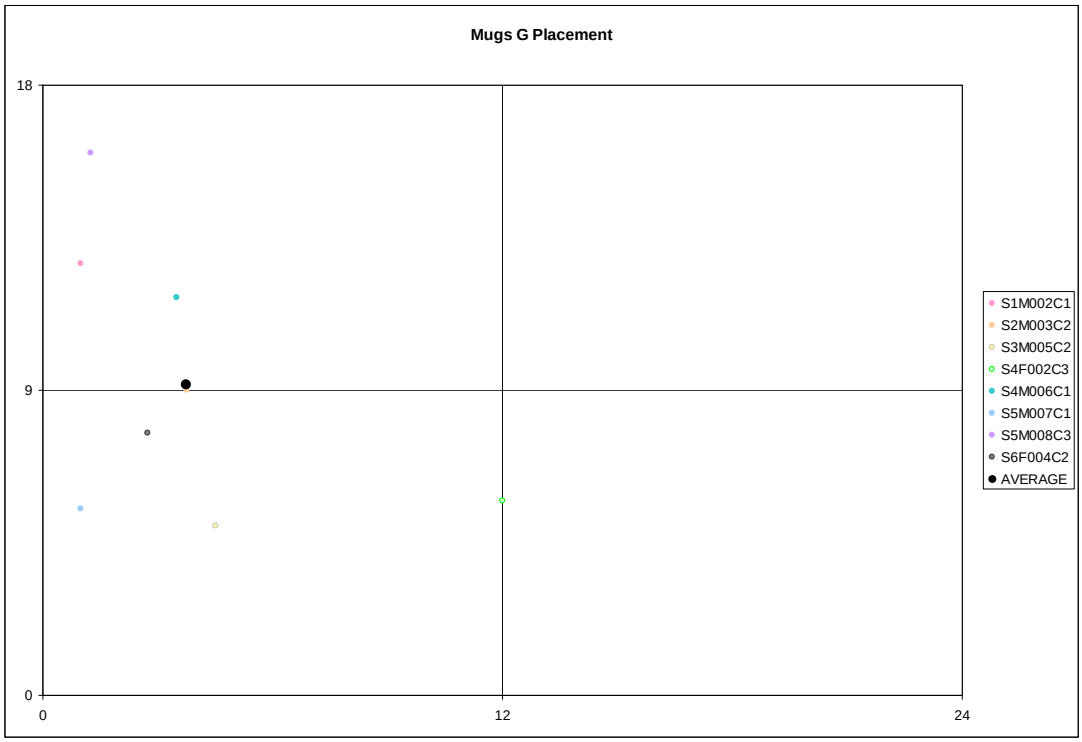


Figure 39. Continued.



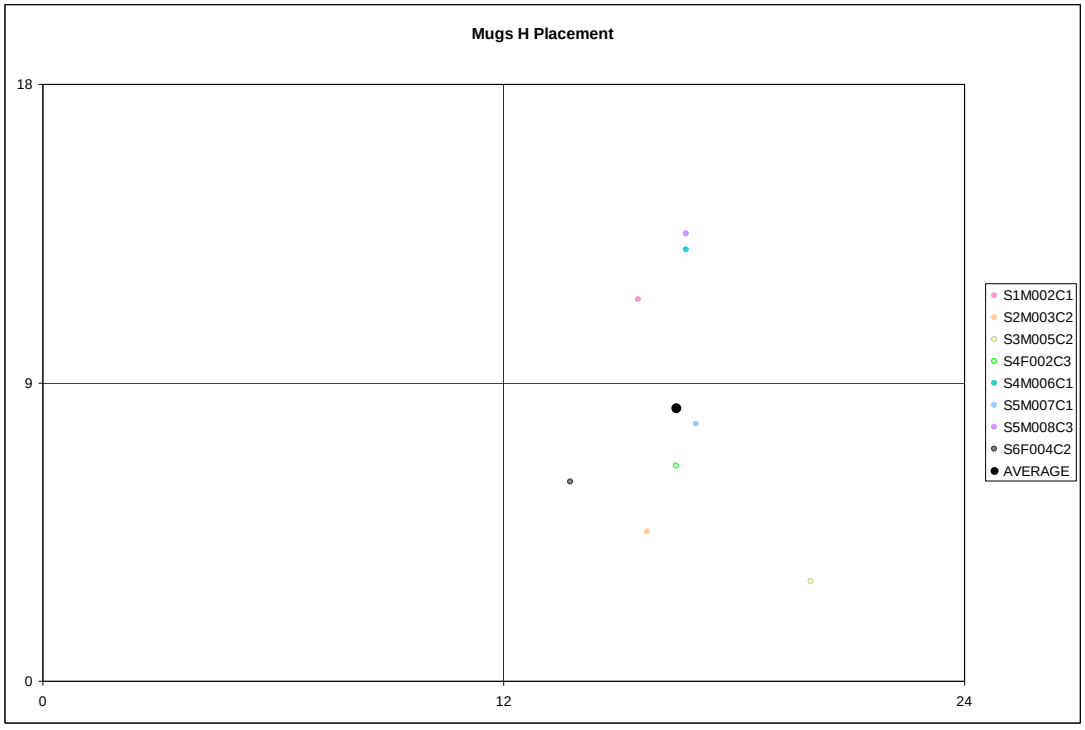
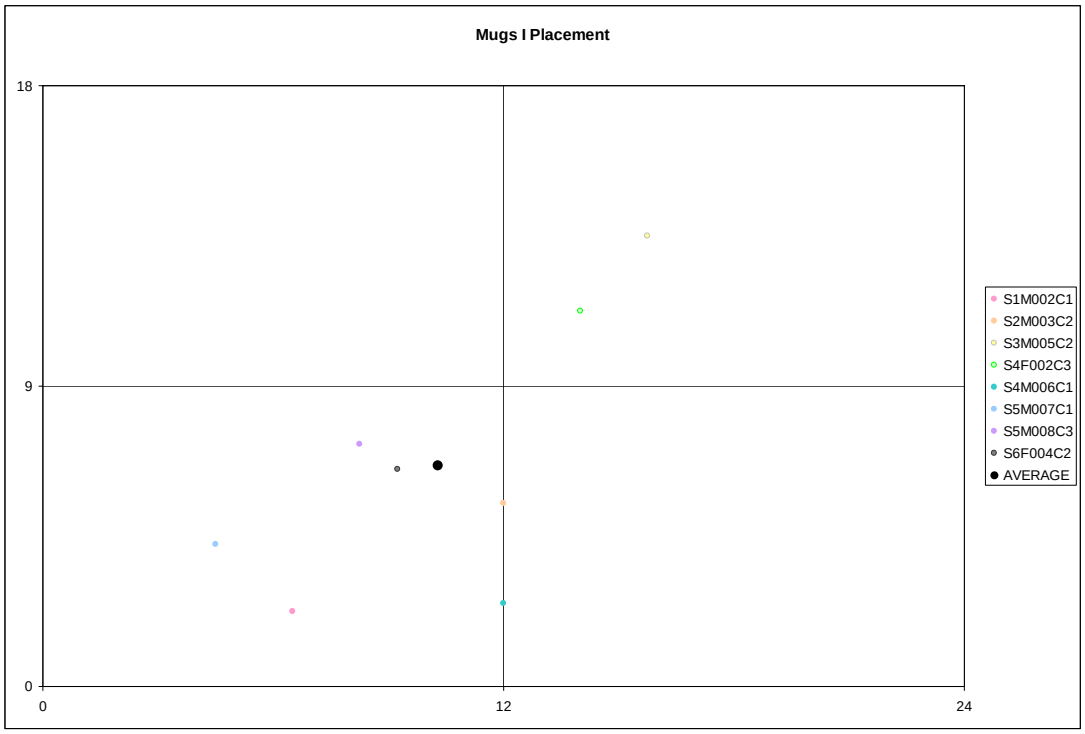


Figure 39. Continued.



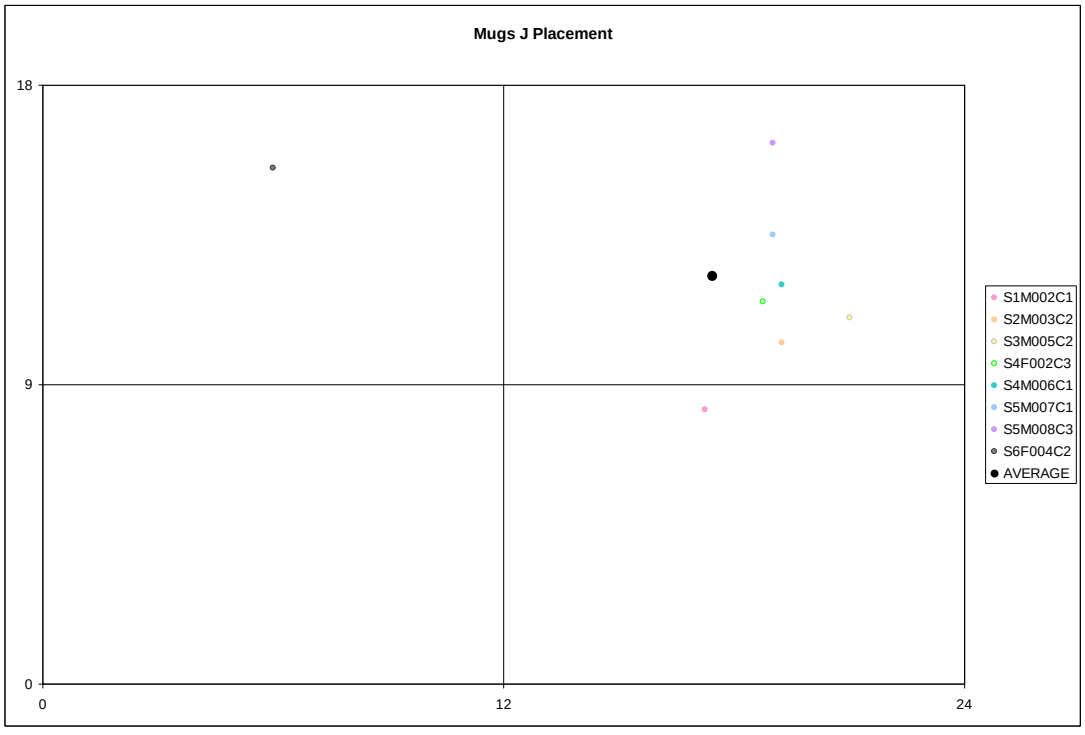
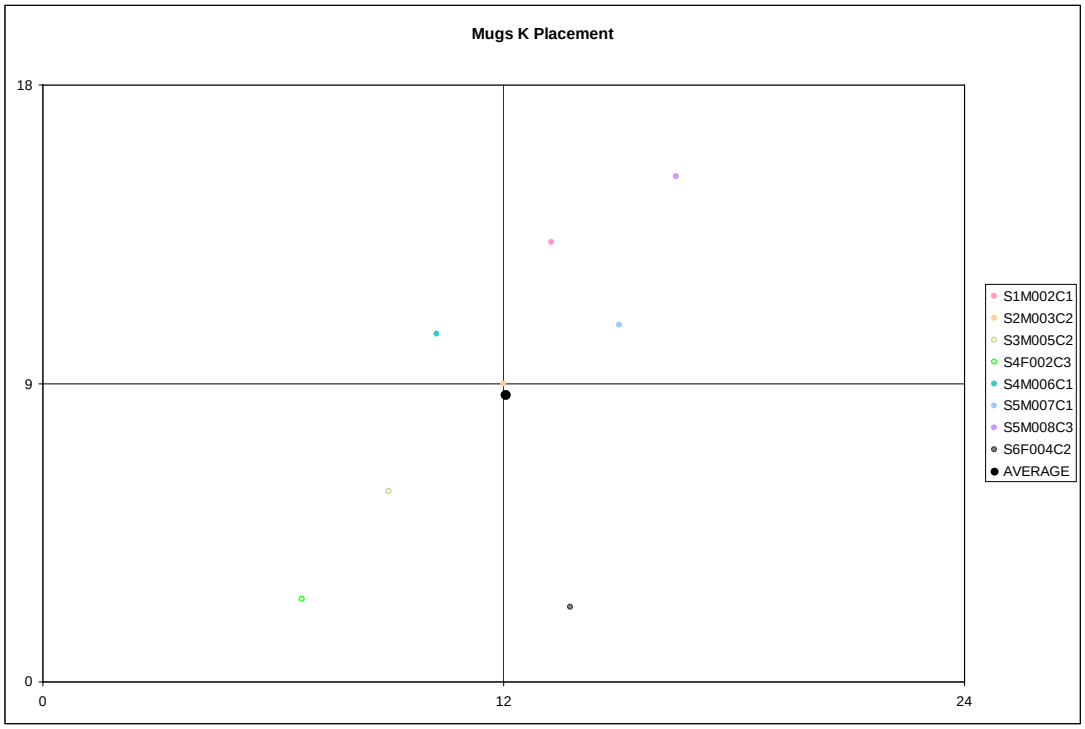


Figure 39. Continued.



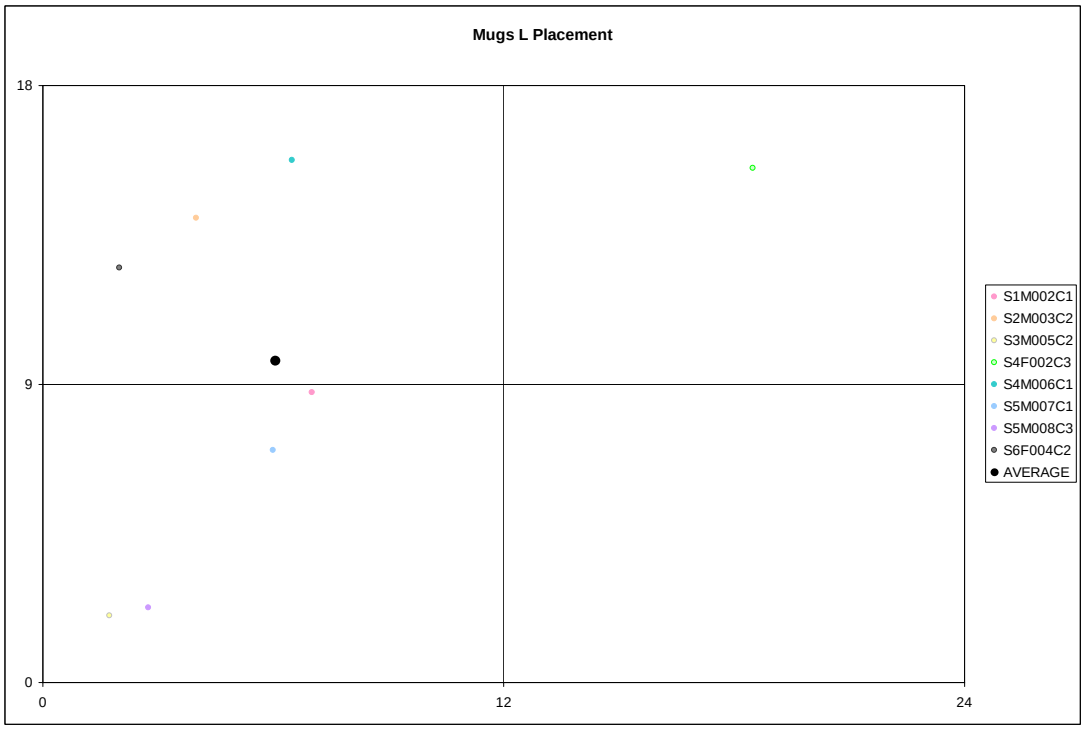
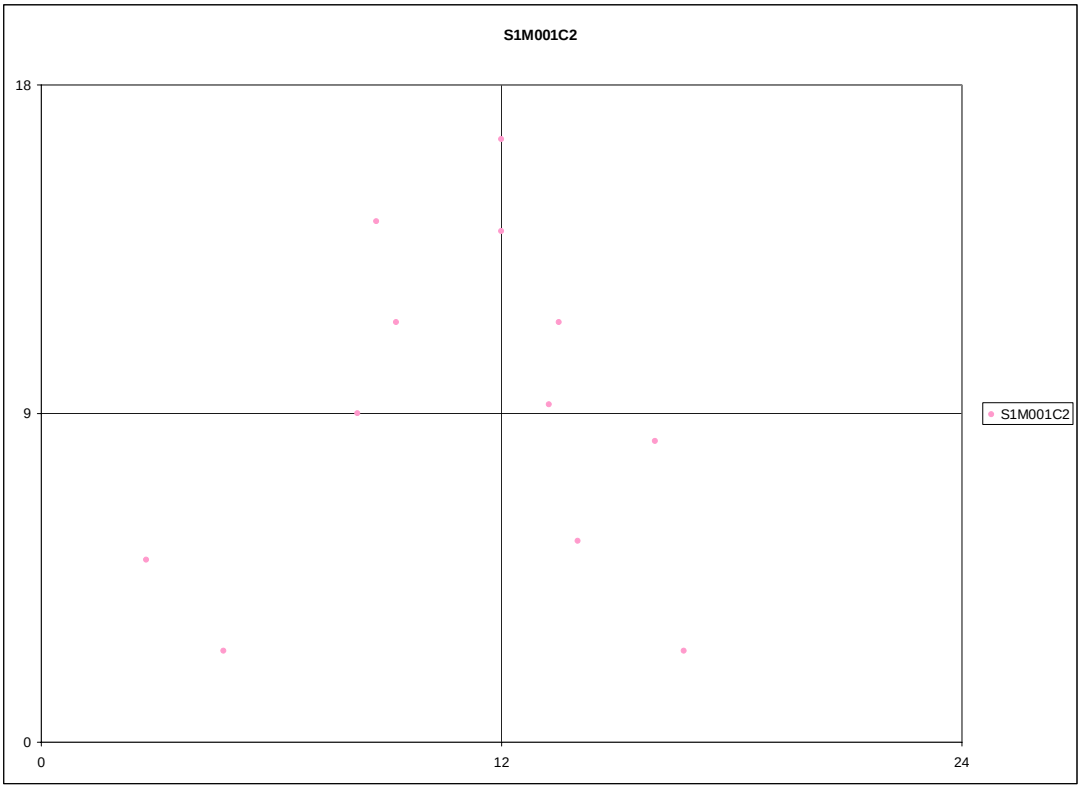


Figure 39. Continued.

Table 41. Mugs Ranked by Normalized Score.

	Mug	Score
C		3.077846
J		2.69713
F		0.869487
H		0.586283
A		0.173238
E		-0.12306
K		-0.23211
B		-0.73136
L		-1.11901
I		-1.58995
D		-1.70166
G		-1.90683



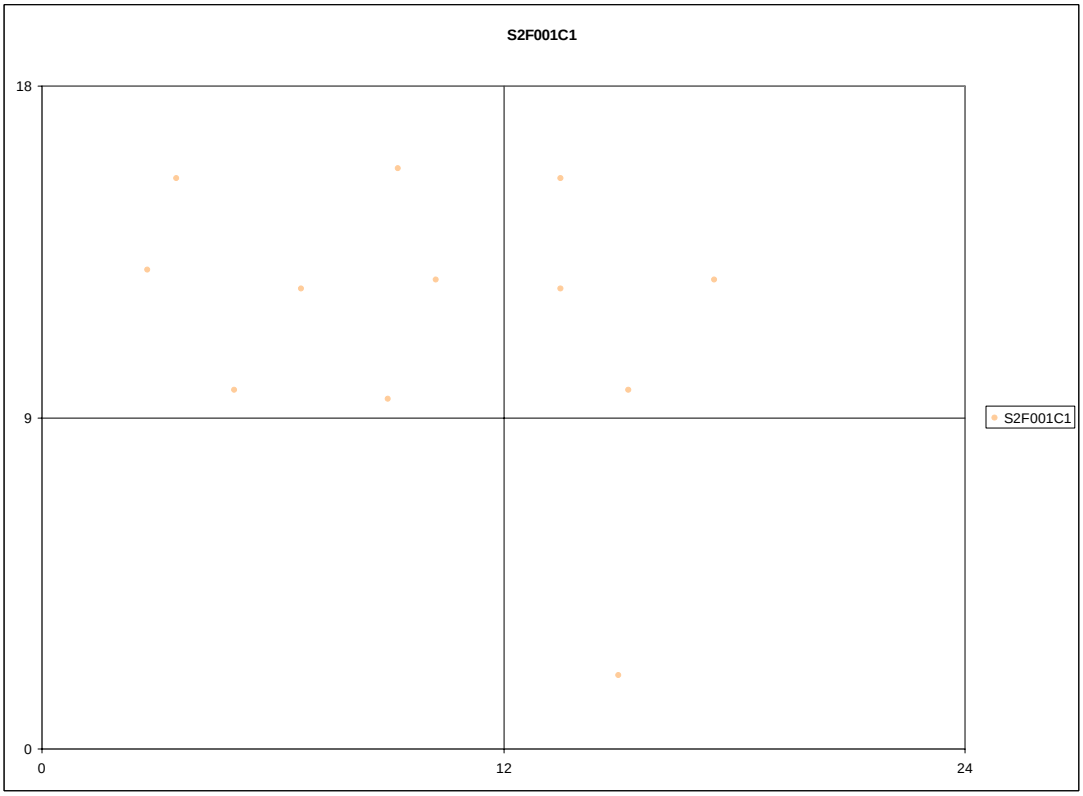
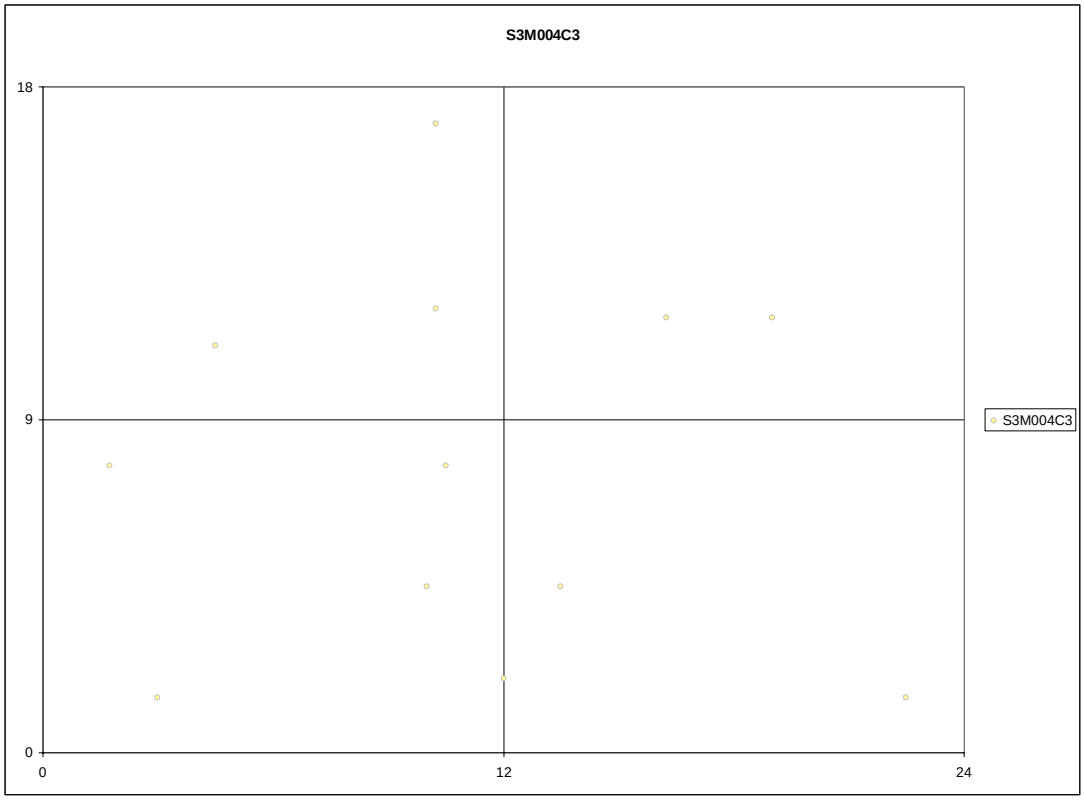


Figure 40. Boot Product Placement By Subject.



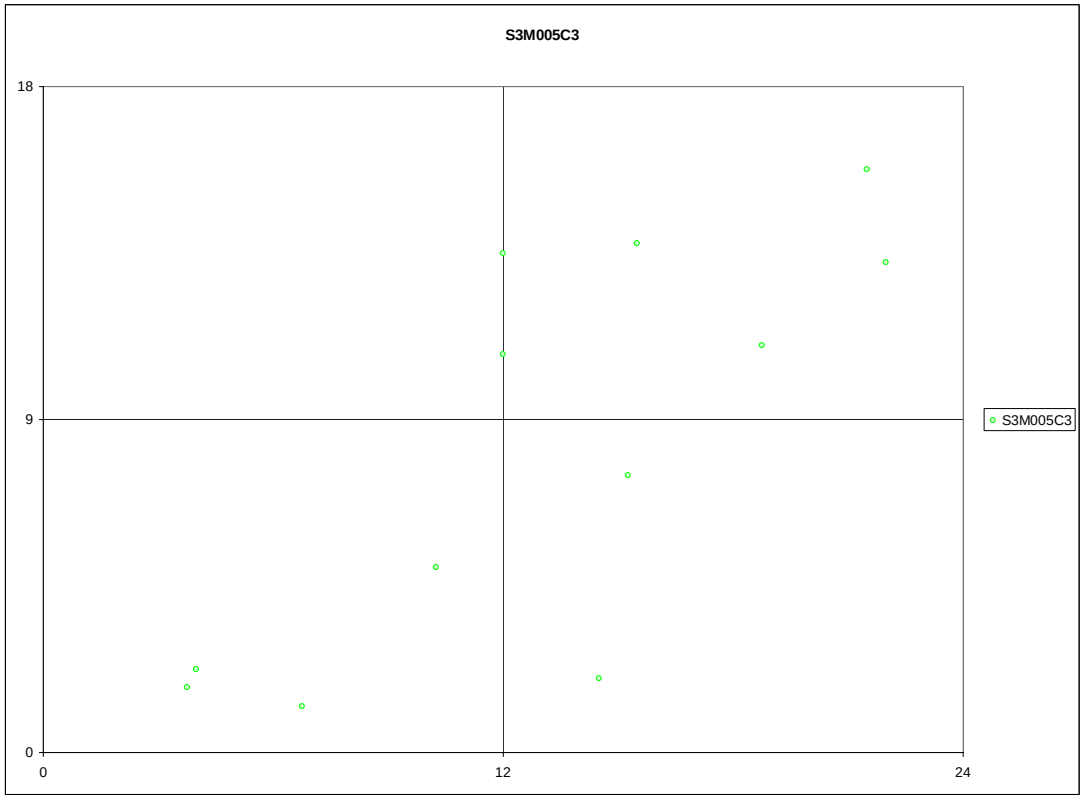
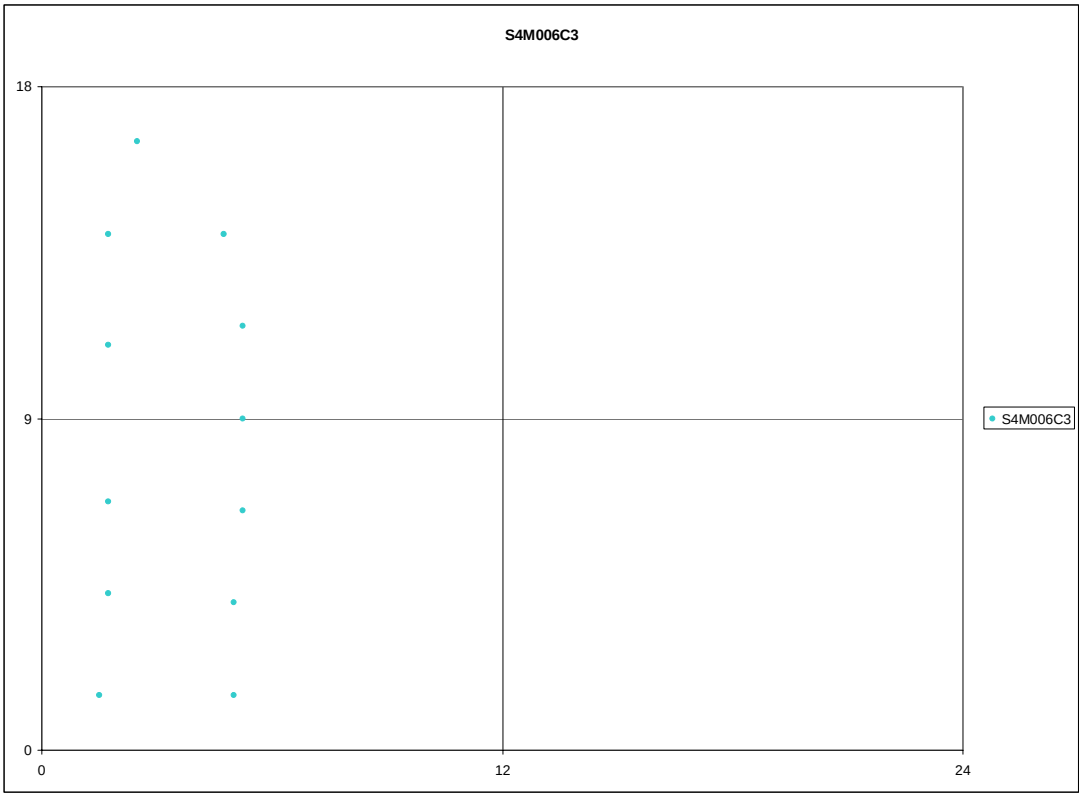


Figure 40. Continued.



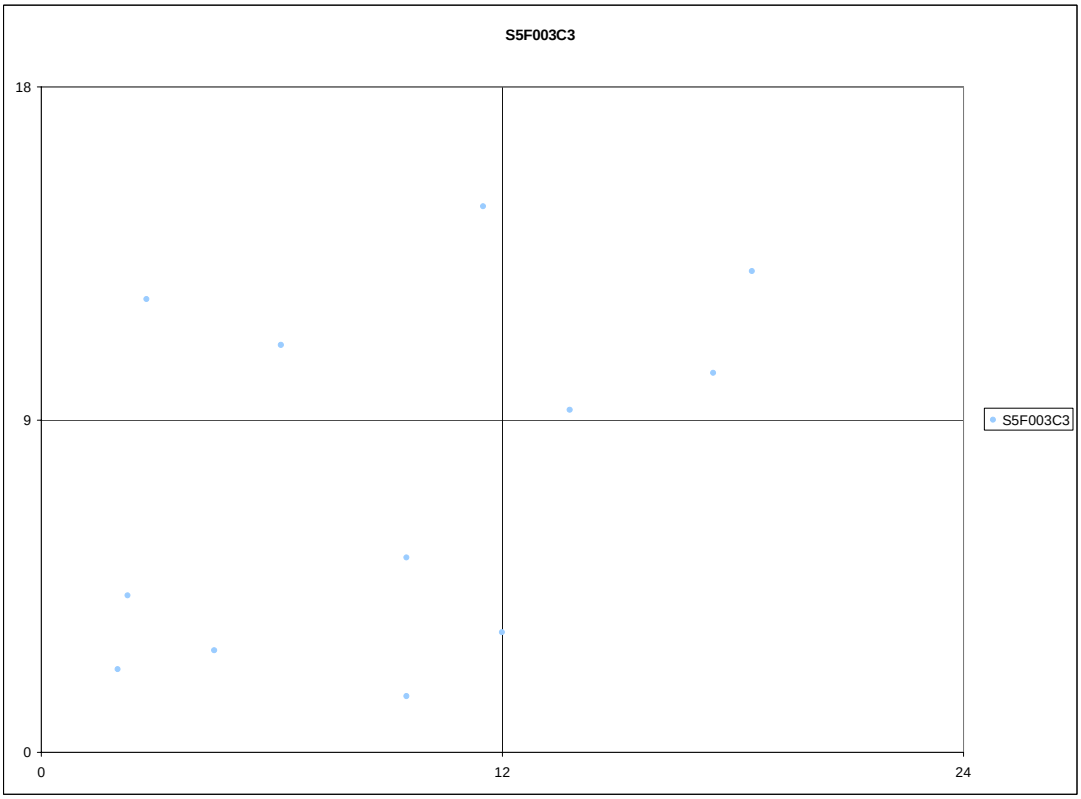


Figure 40. Continued.

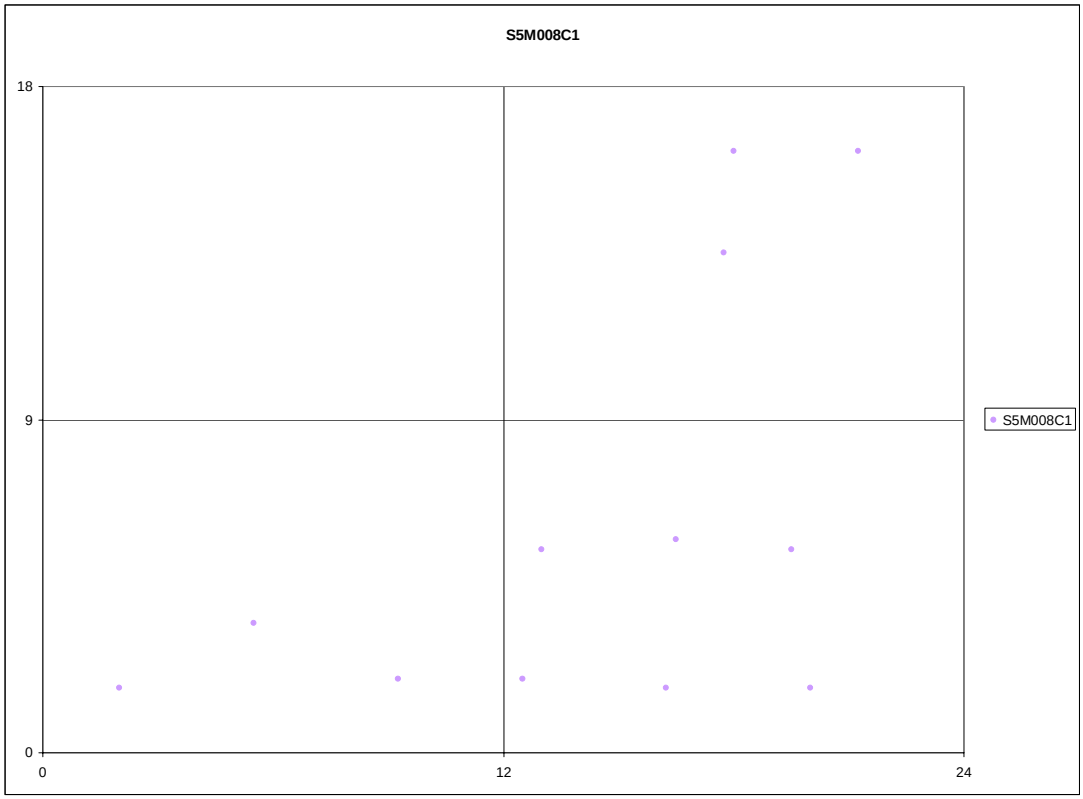


Figure 40. Continued.

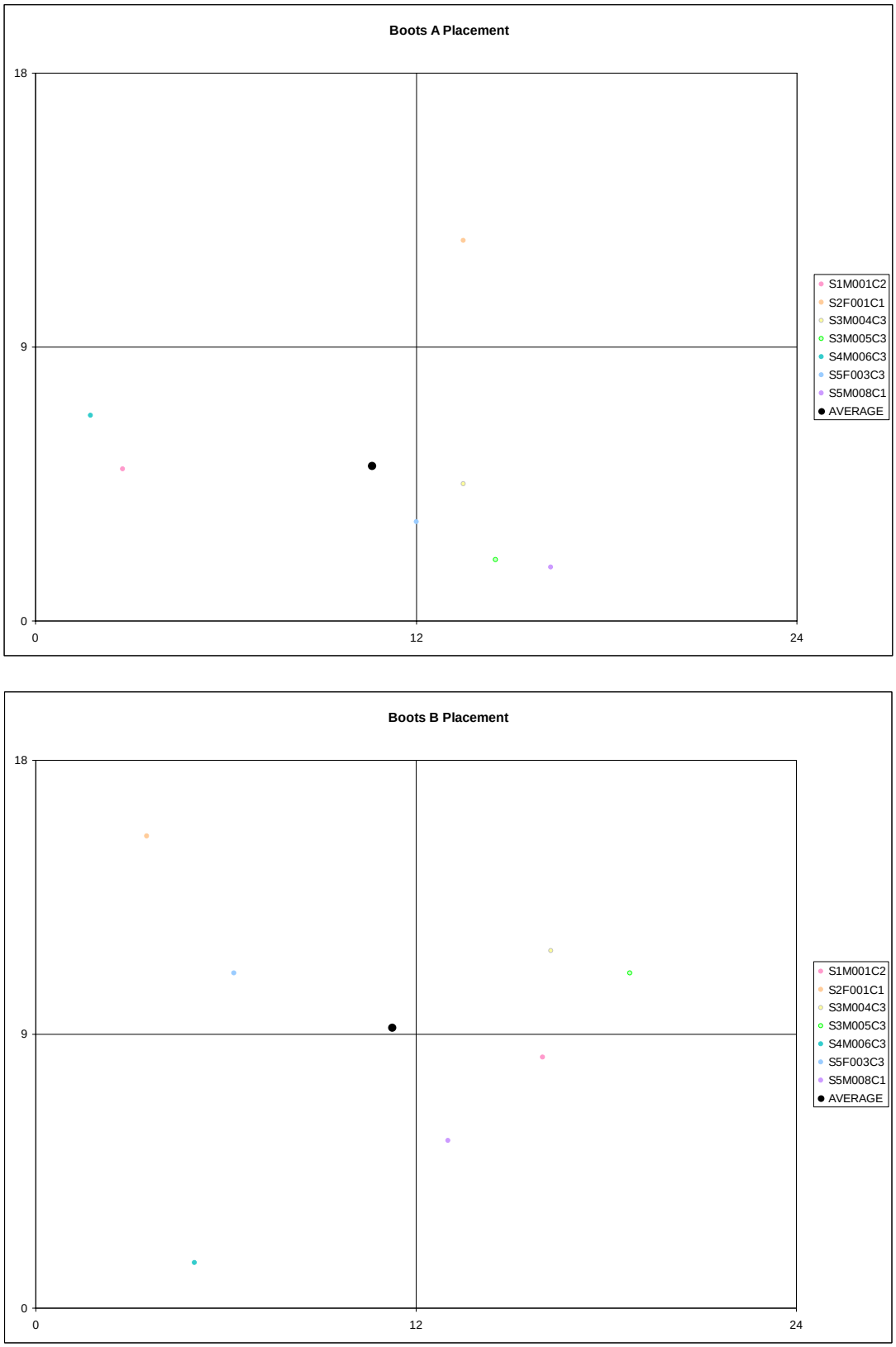
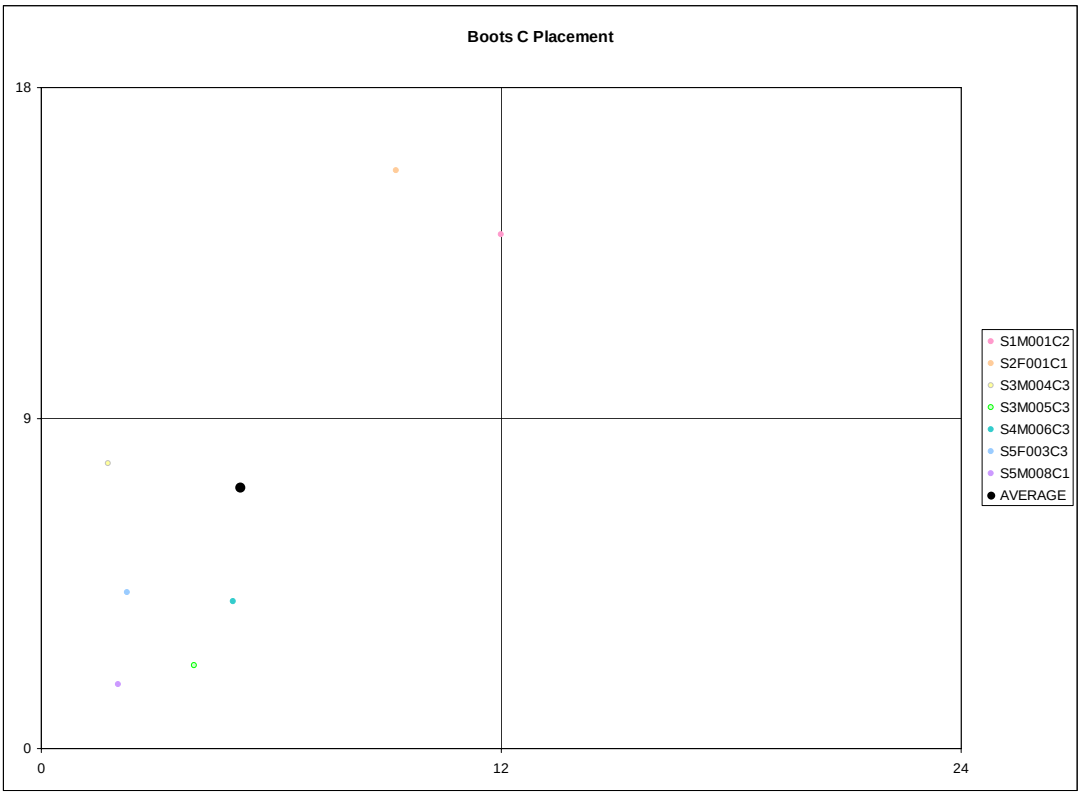


Figure 41. Boot Product Category Placement by Product, with Averages.



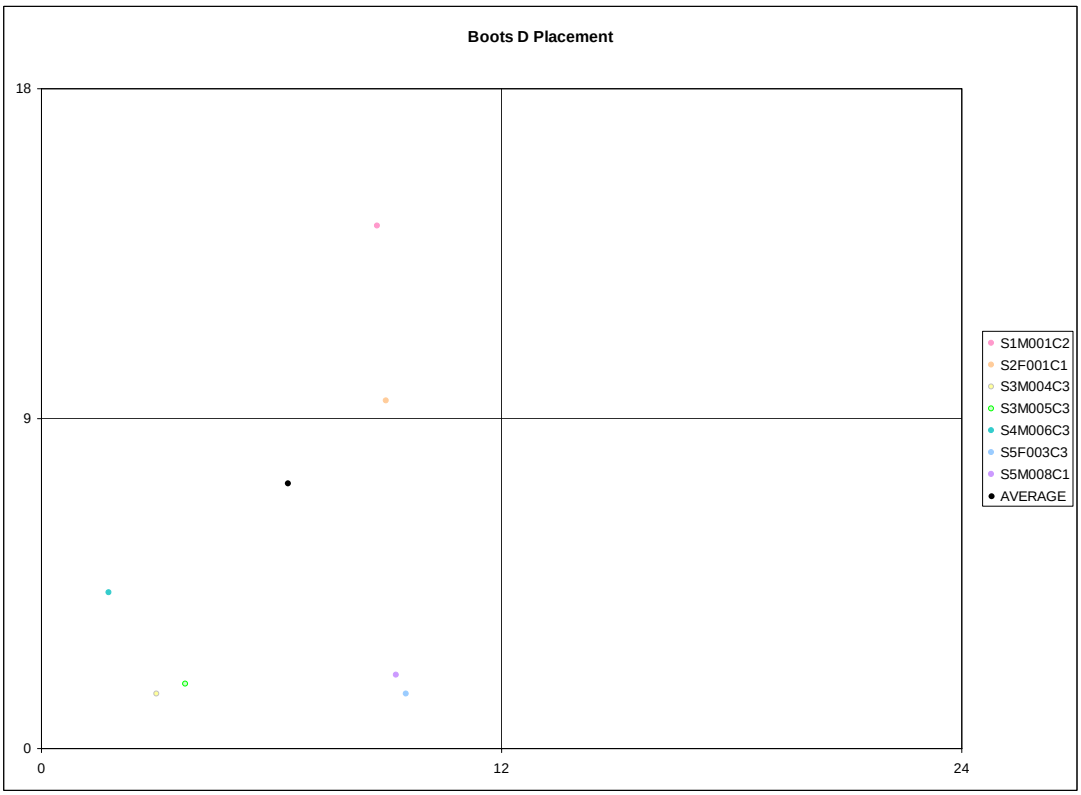
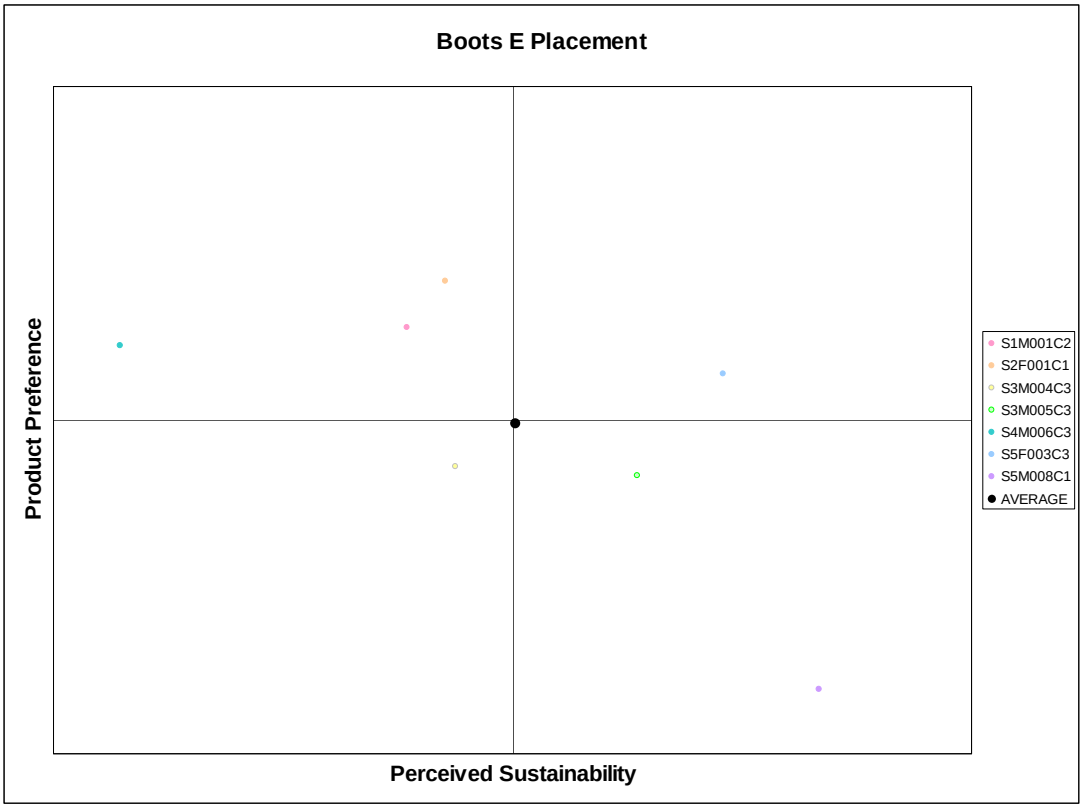


Figure 41. Continued.



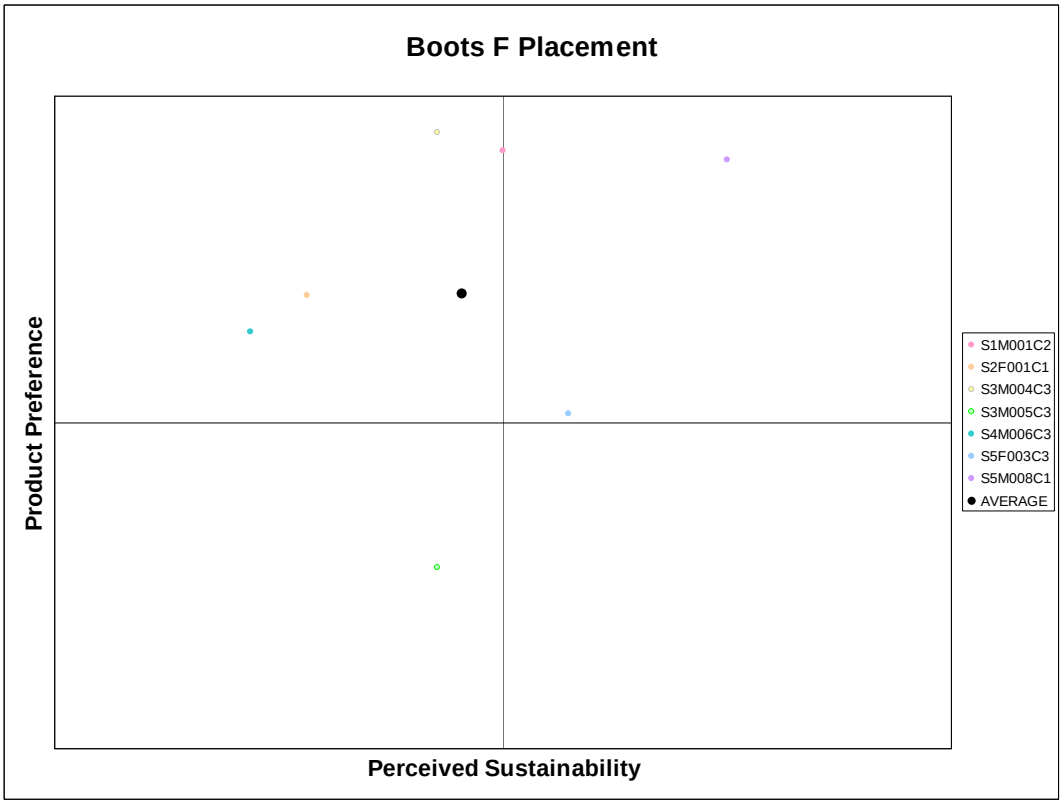
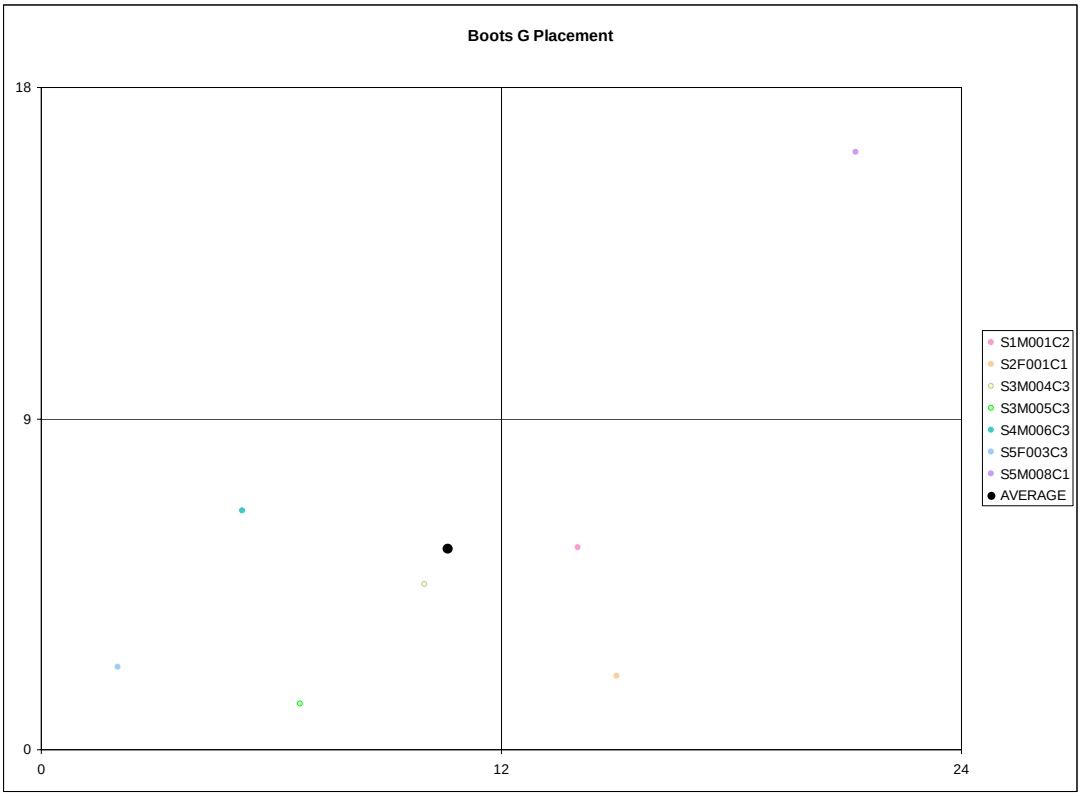


Figure 41. Continued.



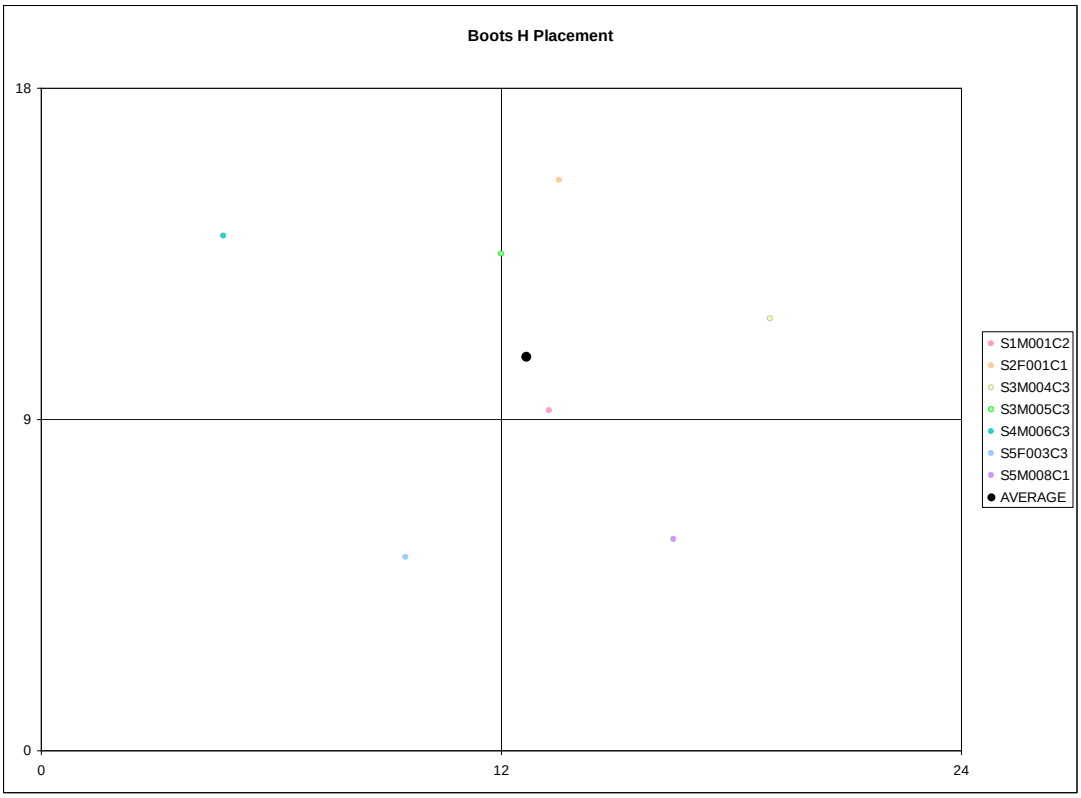
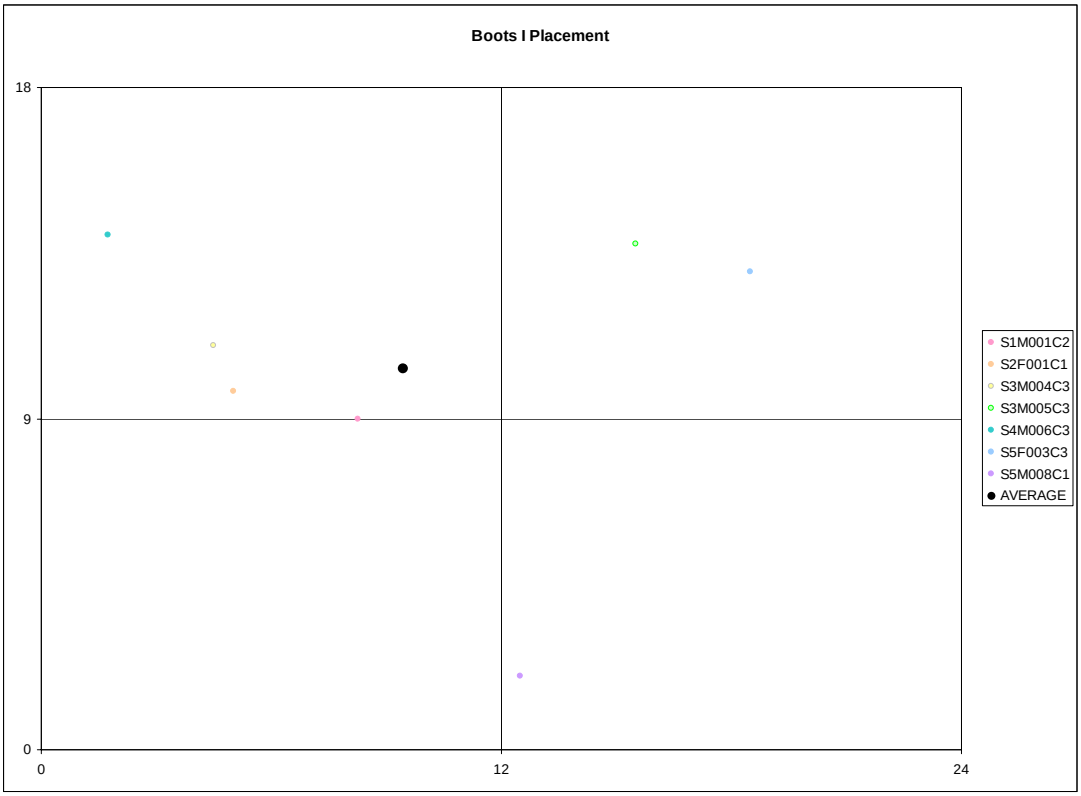


Figure 41. Continued.



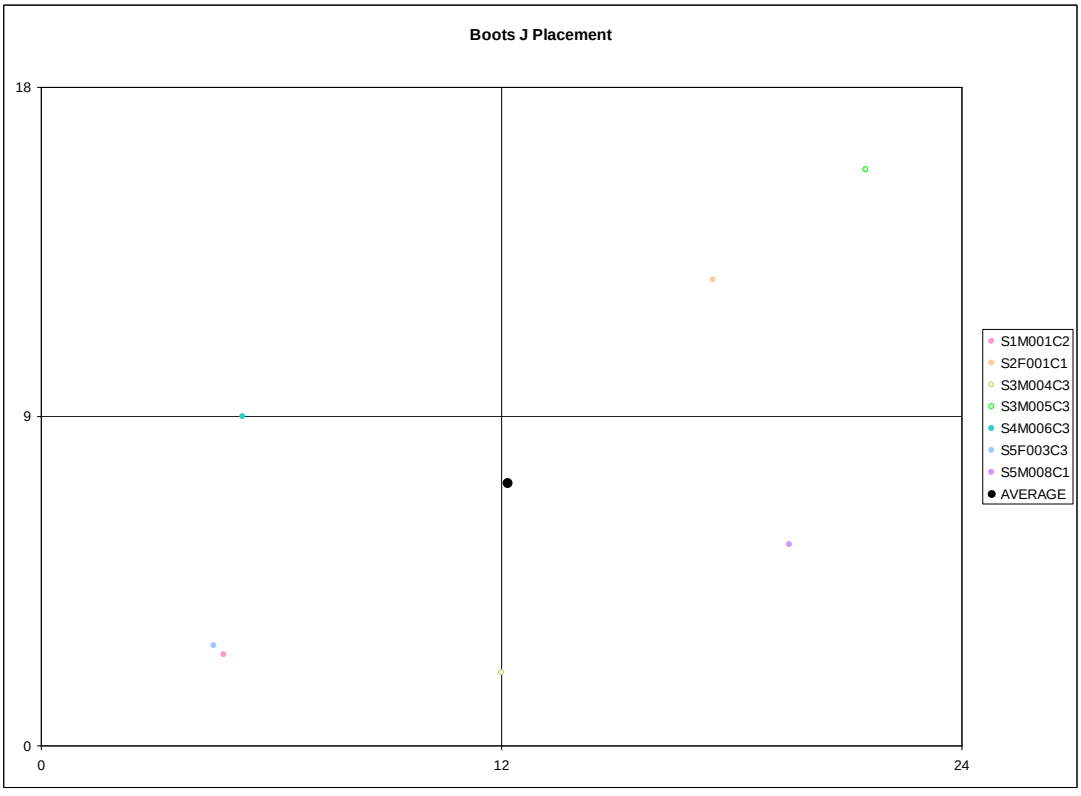
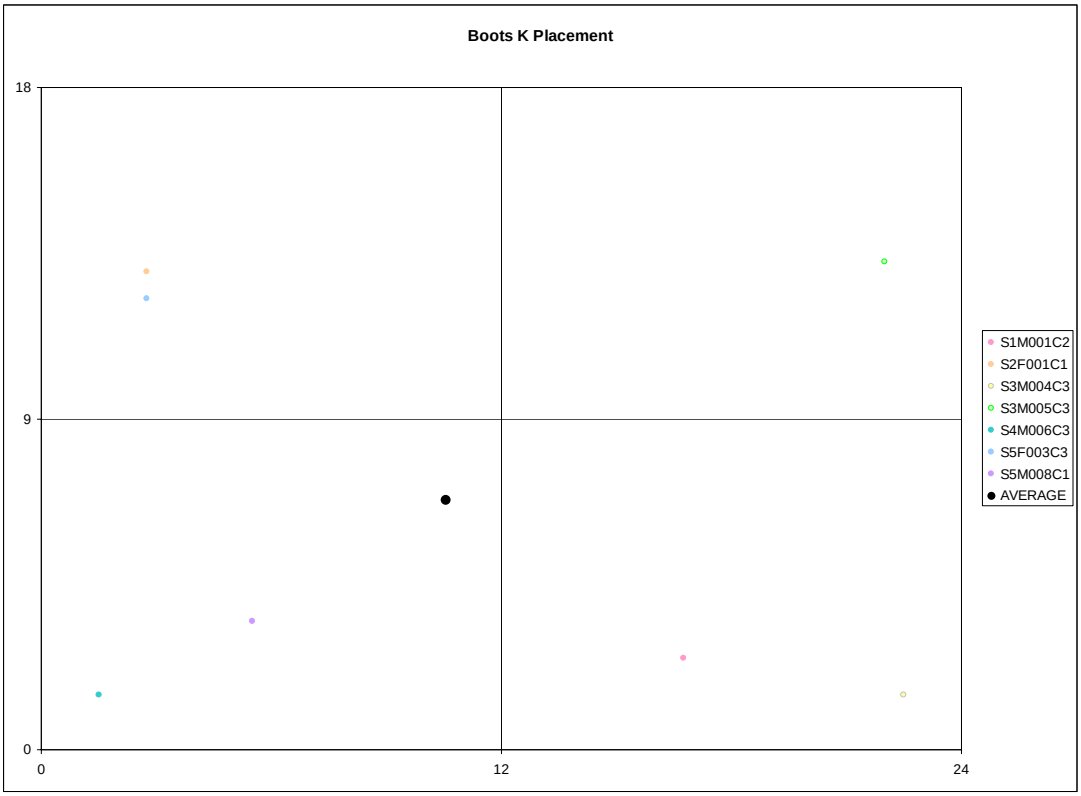


Figure 41. Continued.



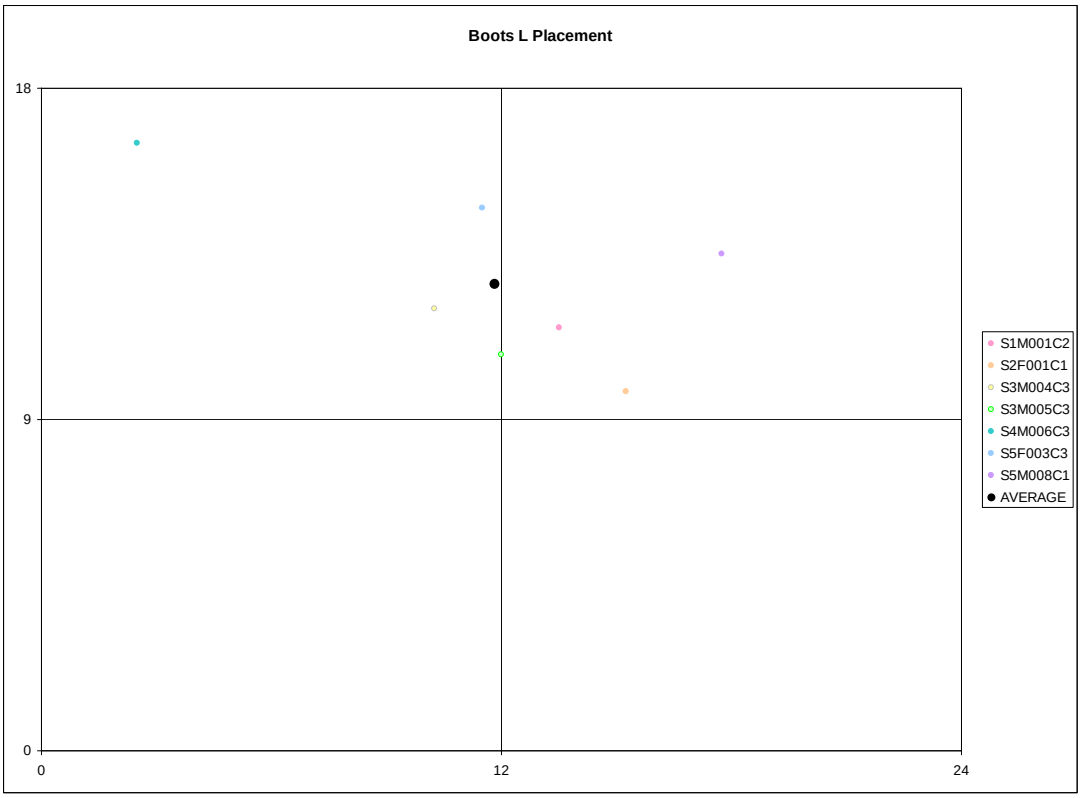


Figure 41. Continued.

Table 42. Boots Ranked by Normalized Score.

	Boot	Score
L		2.214021
H		1.856652
F		1.769941
E		0.956779
B		0.70257
J		0.350333
I		0.324456
K		-0.49384
G		-0.94414
A		-1.07426
C		-2.71351
D		-2.949

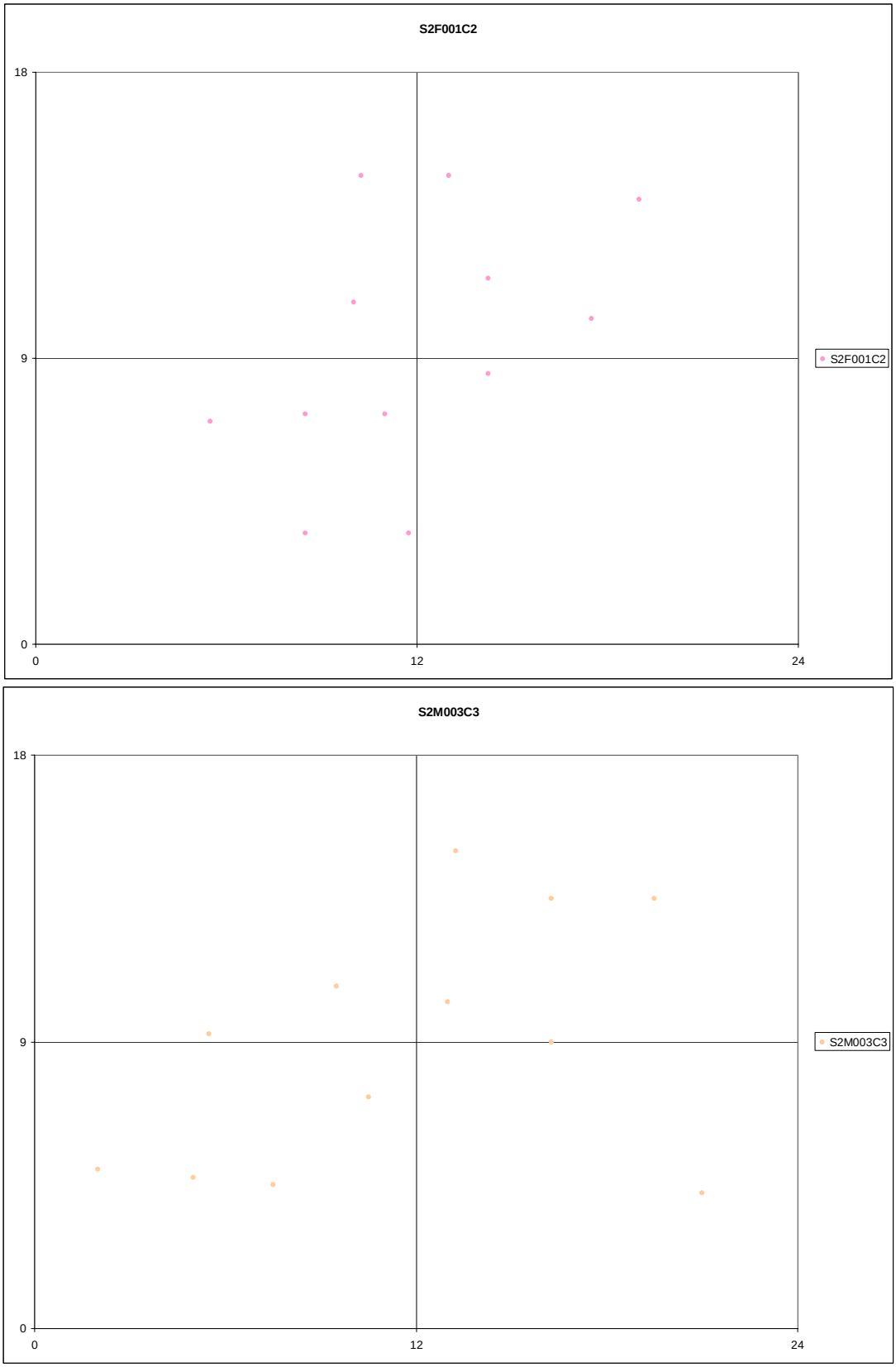


Figure 42. Lamp Product Category Ranked by Subject.

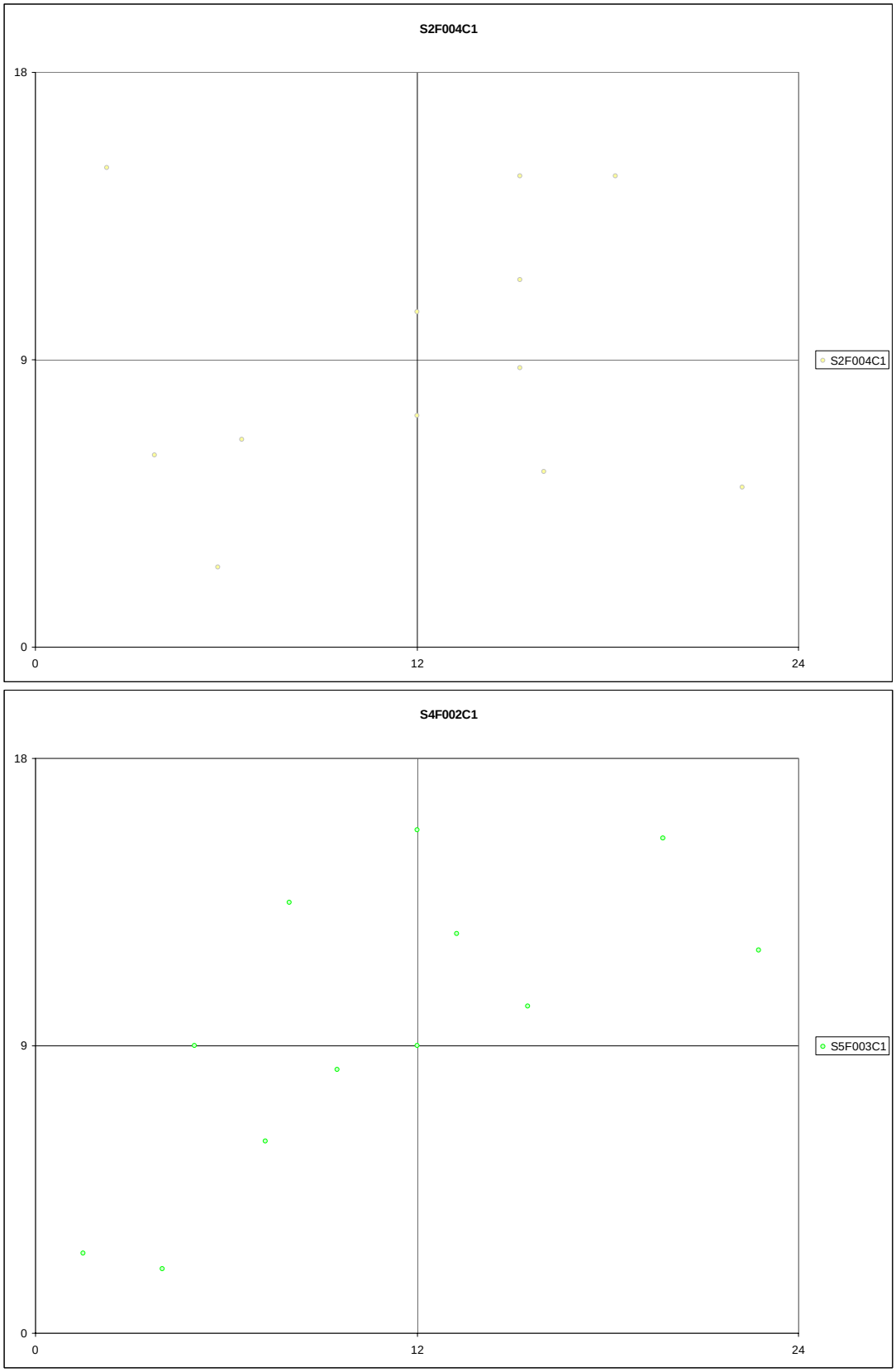


Figure 42. Continued.

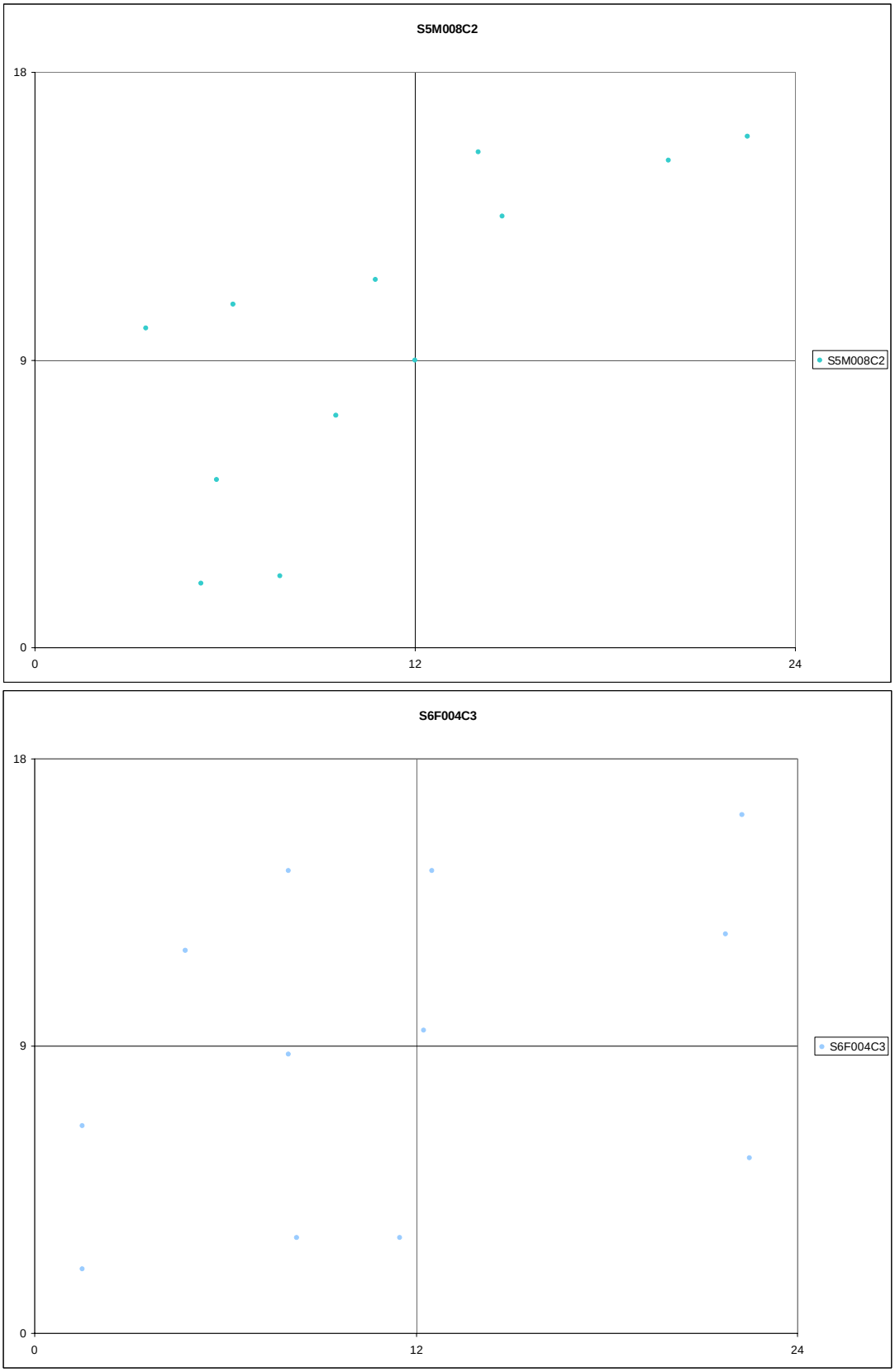


Figure 42. Continued.

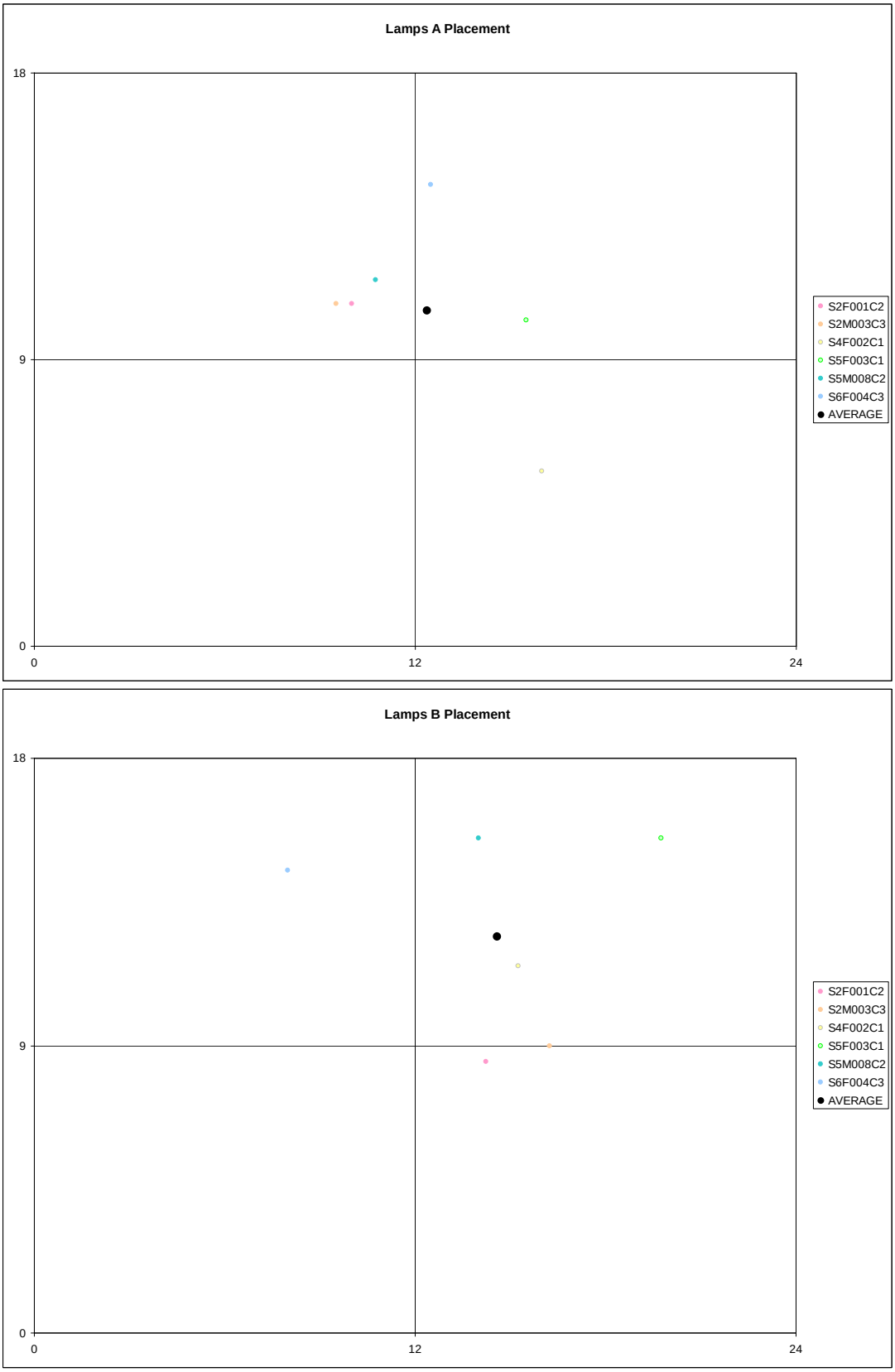
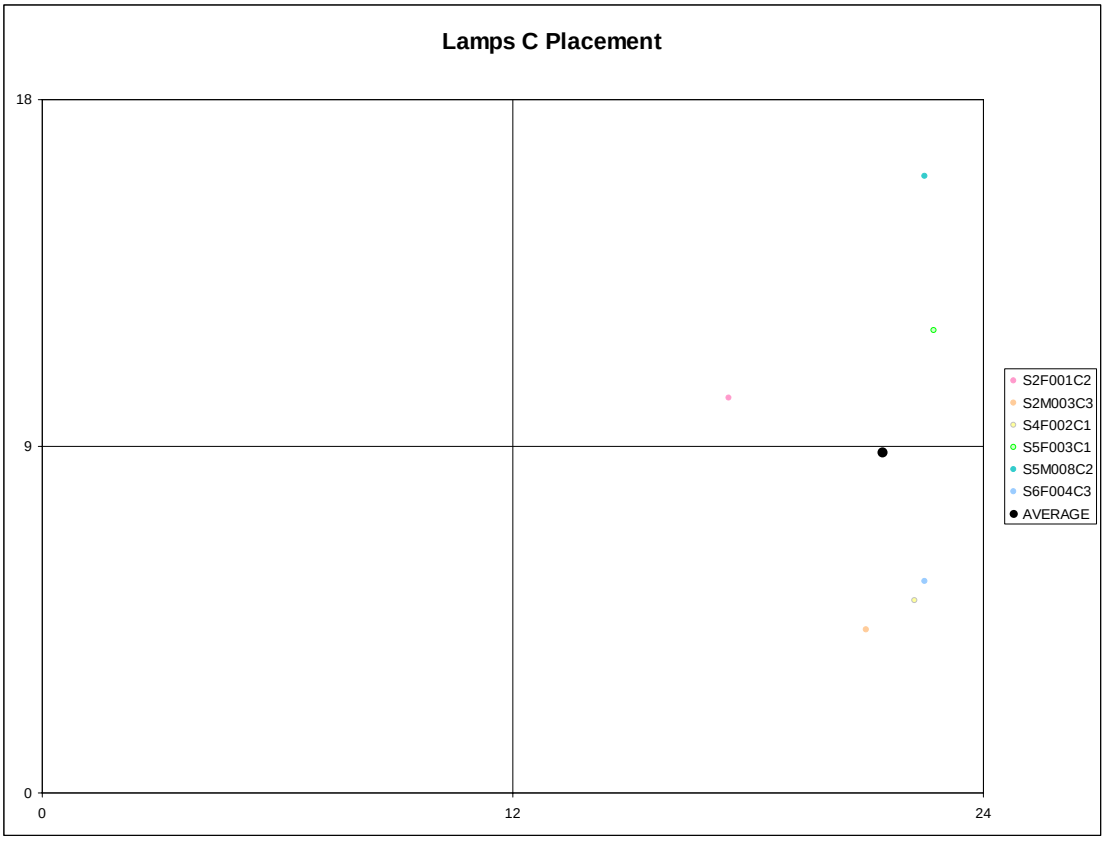


Figure 43. Lamp Category Placement by Product, with Averages.



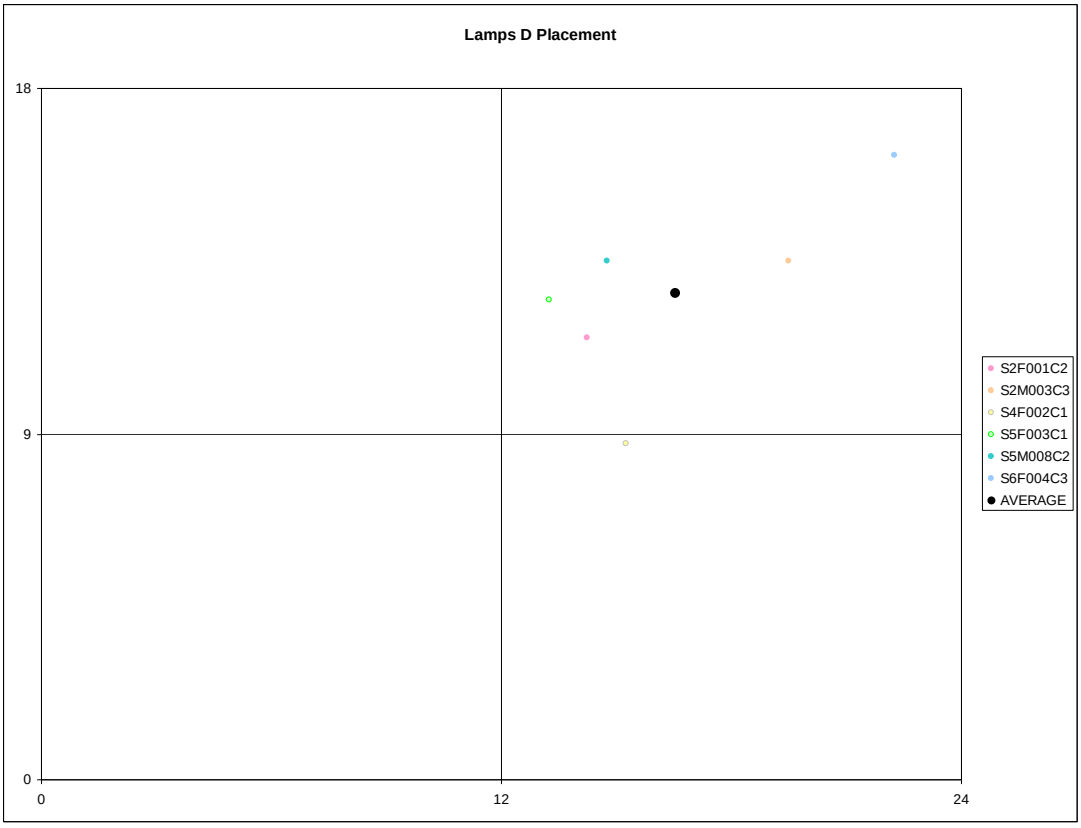
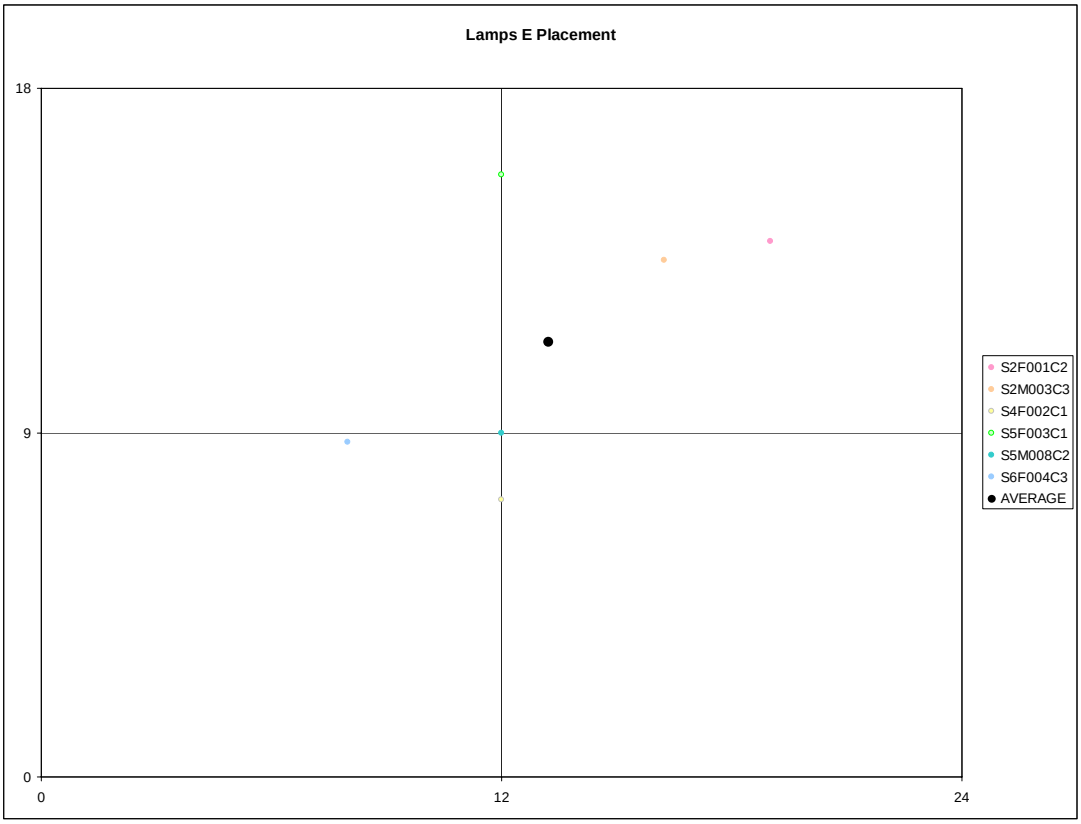


Figure 43. Continued.



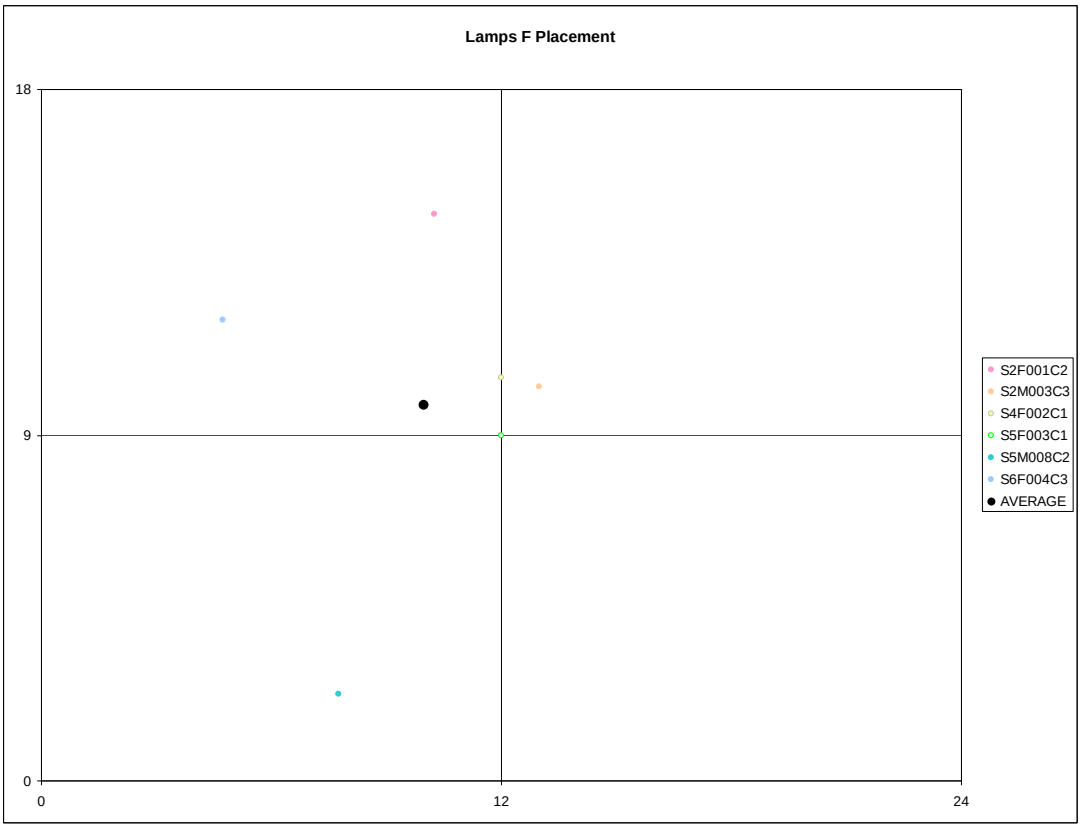
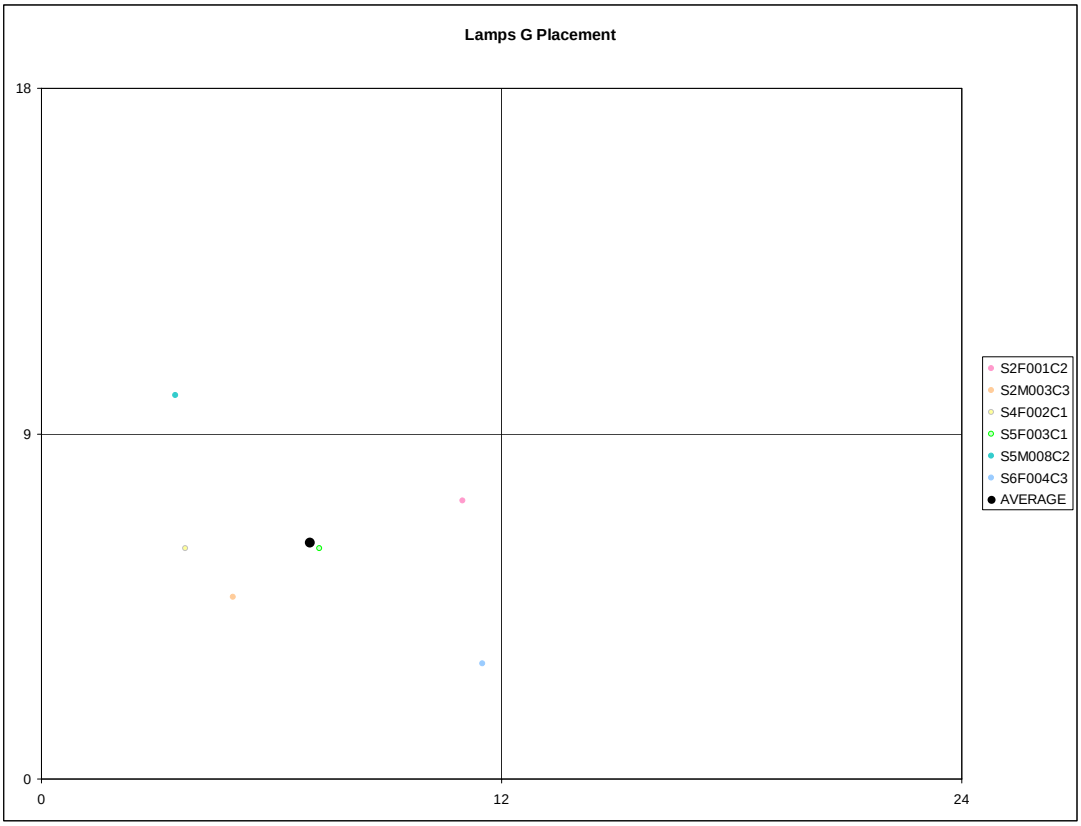


Figure 43. Continued.



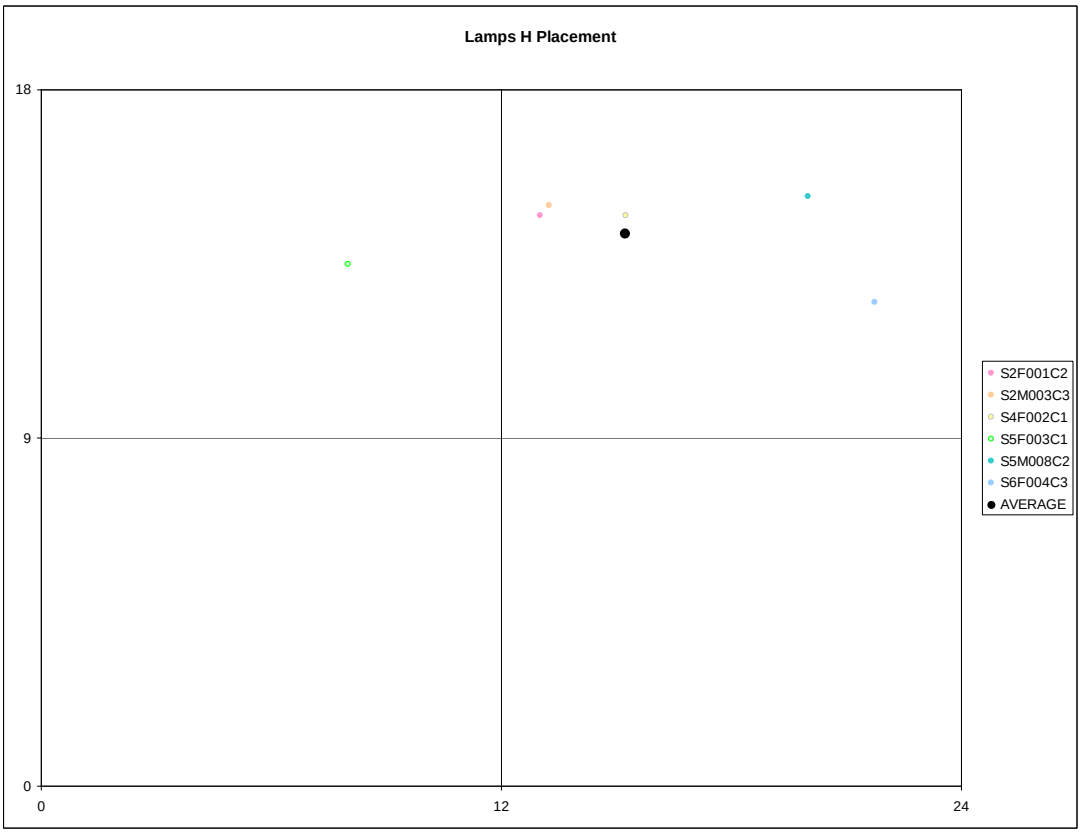
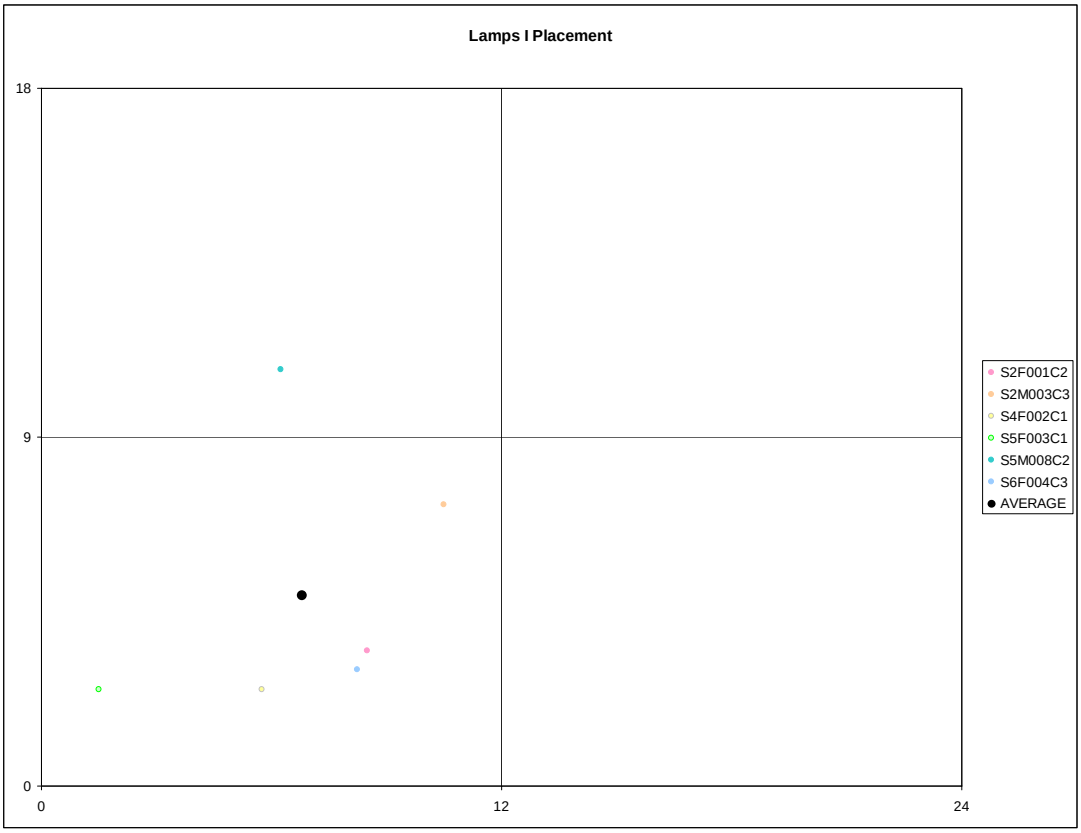


Figure 43. Continued.



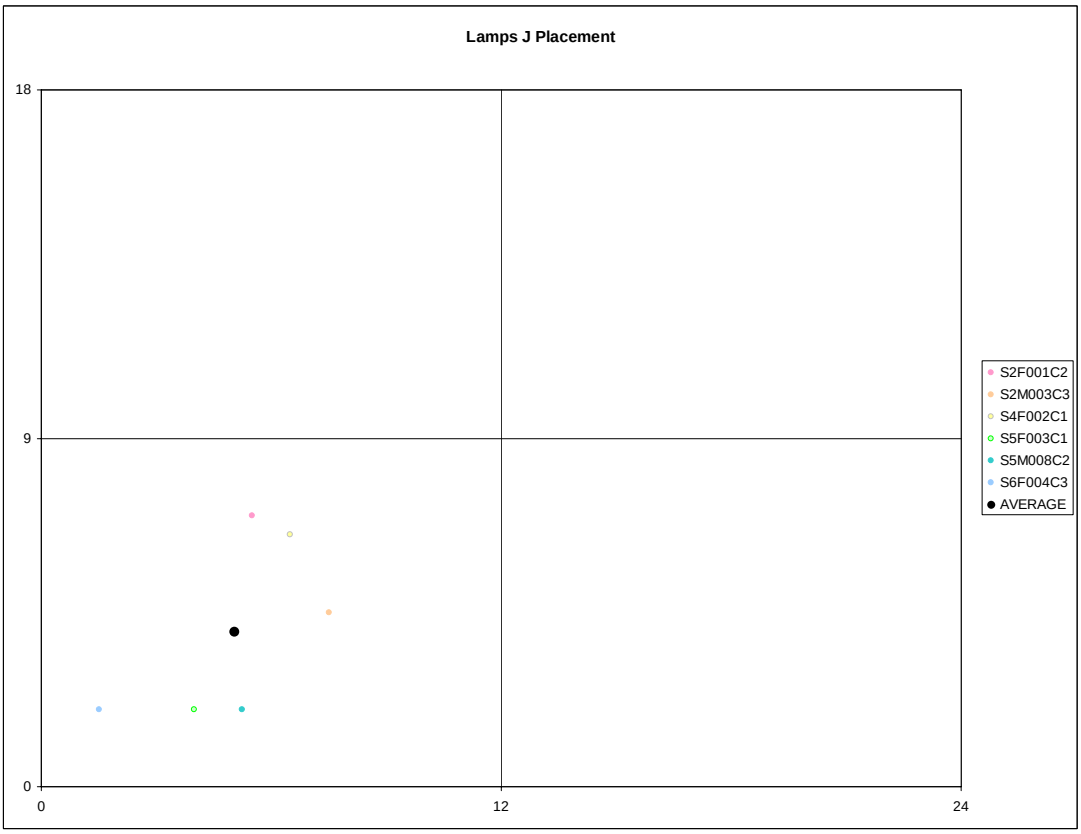


Figure 43. Continued.

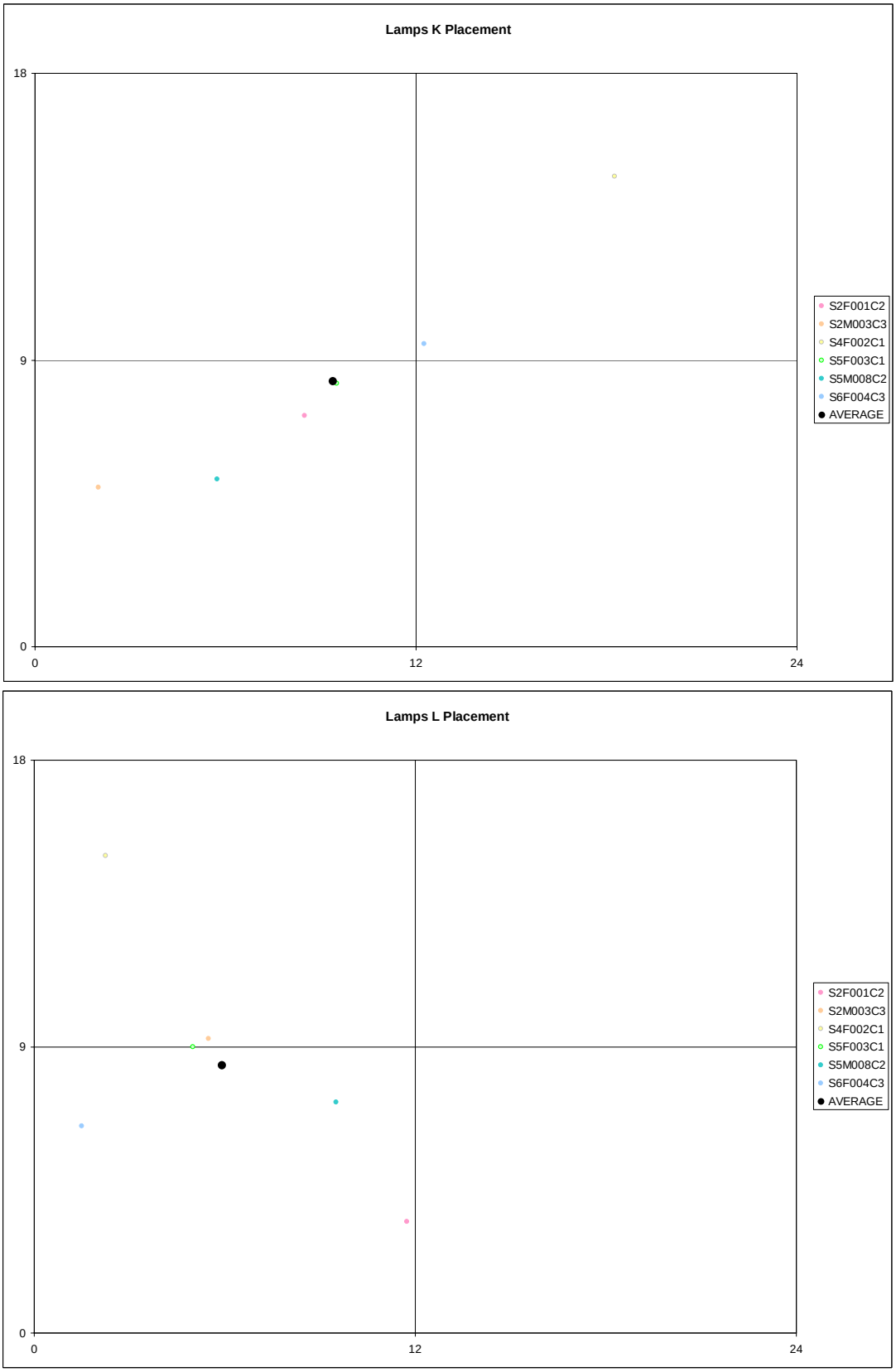


Figure 43. Continued.

Table 43. Lamps Ranked by Normalized Score.

	Lamp	Score
H		2.321014
D		2.077415
C		1.850059
B		1.605558
E		1.001725
A		0.5722
F		-0.14901
K		-0.72499
L		-1.39314
G		-1.88359
I		-2.31873
J		-2.95852

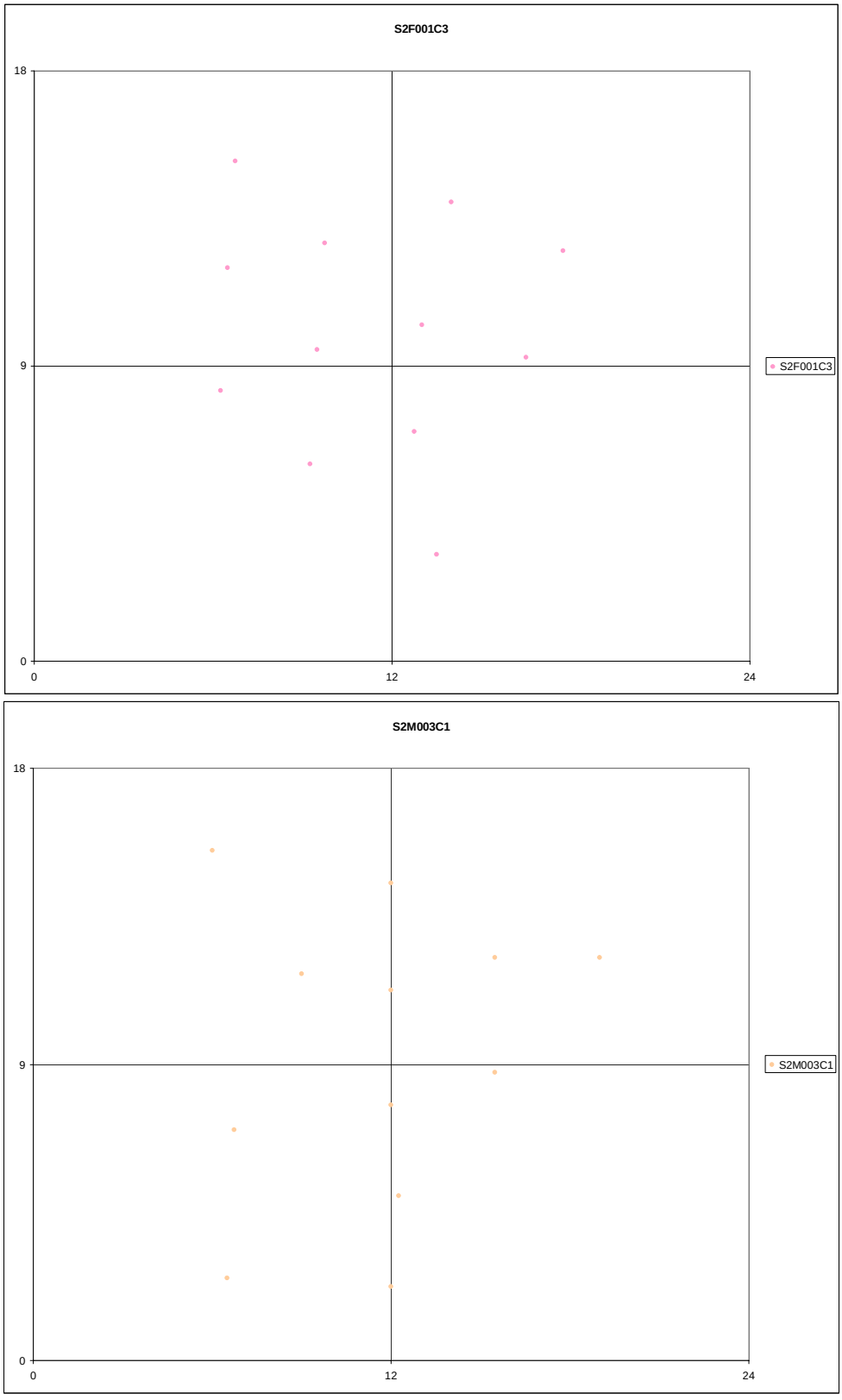
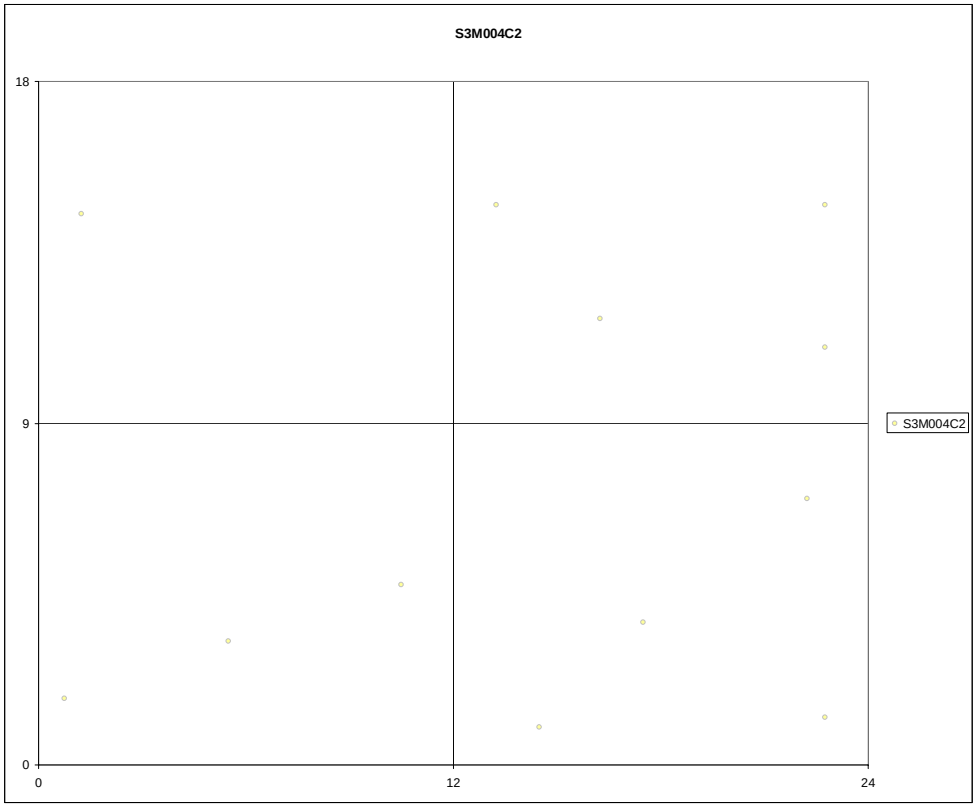


Figure 44. Chair Product Placement by Subject.



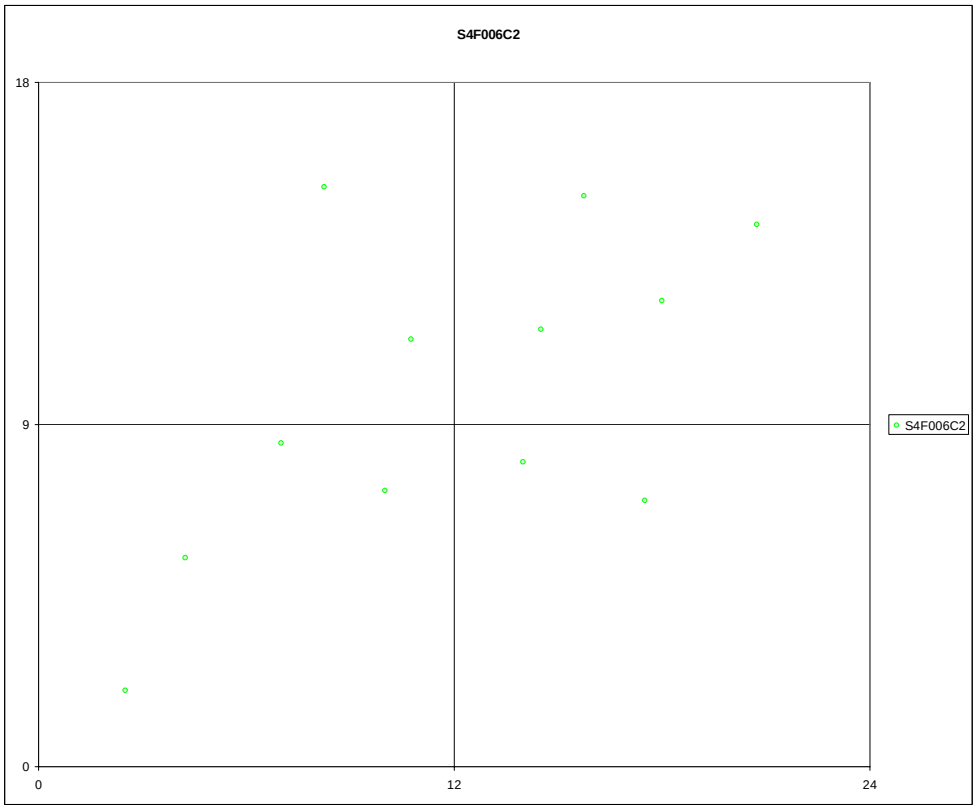


Figure 44. Continued.

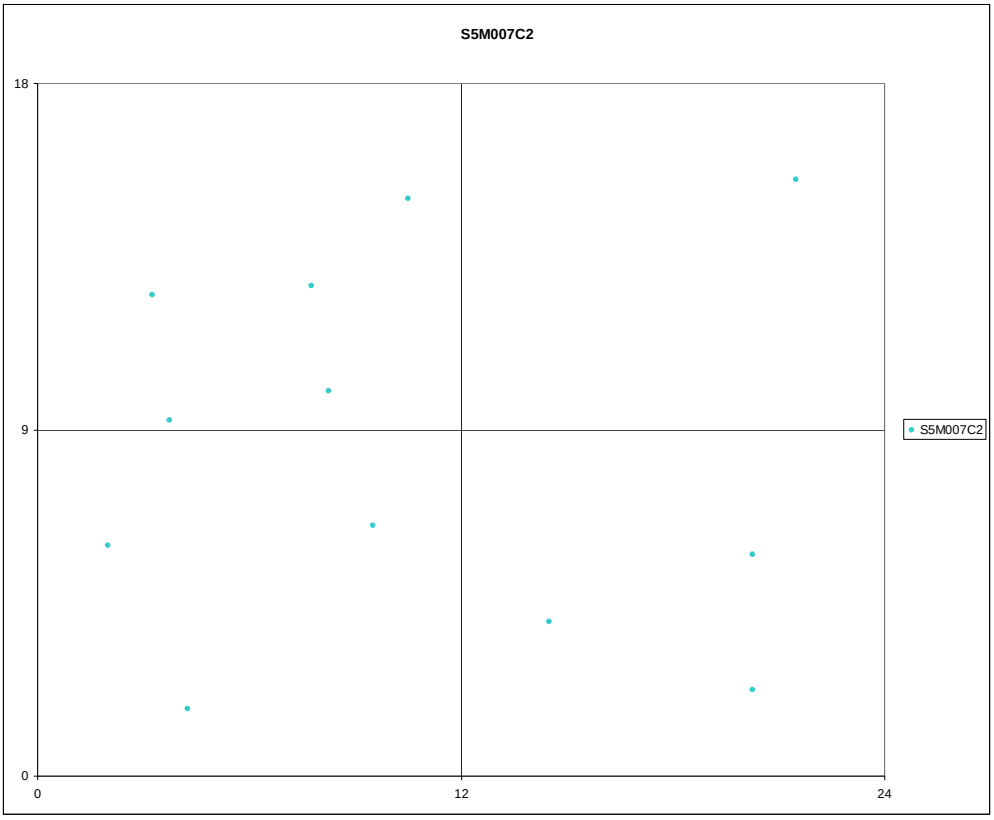
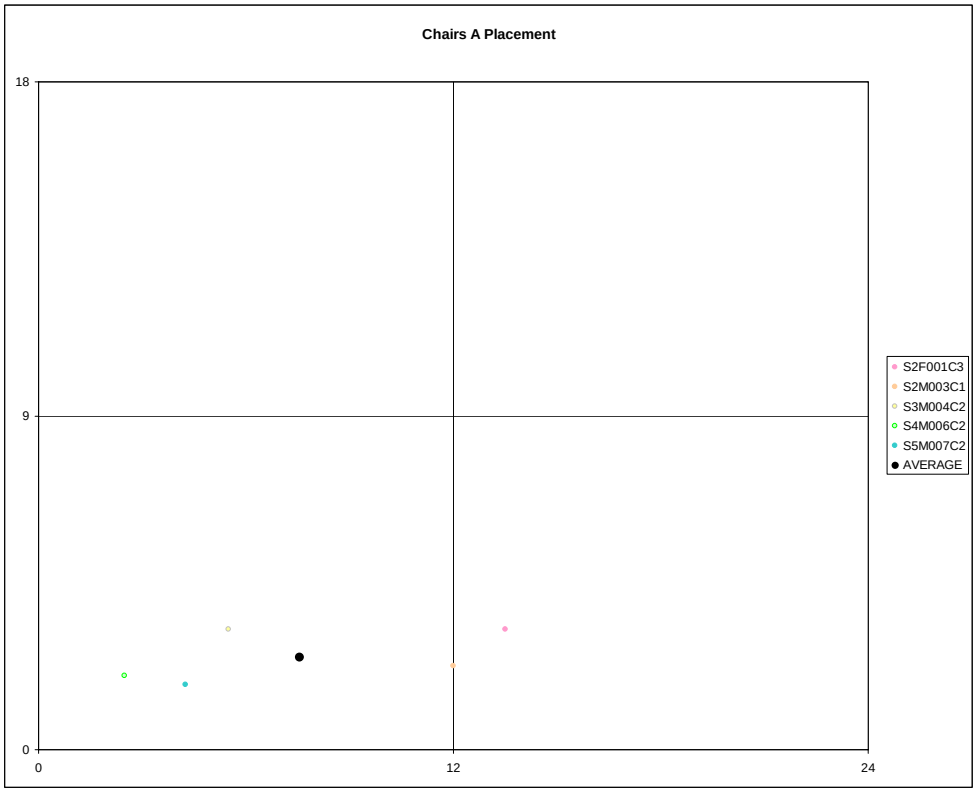


Figure 44. Continued.



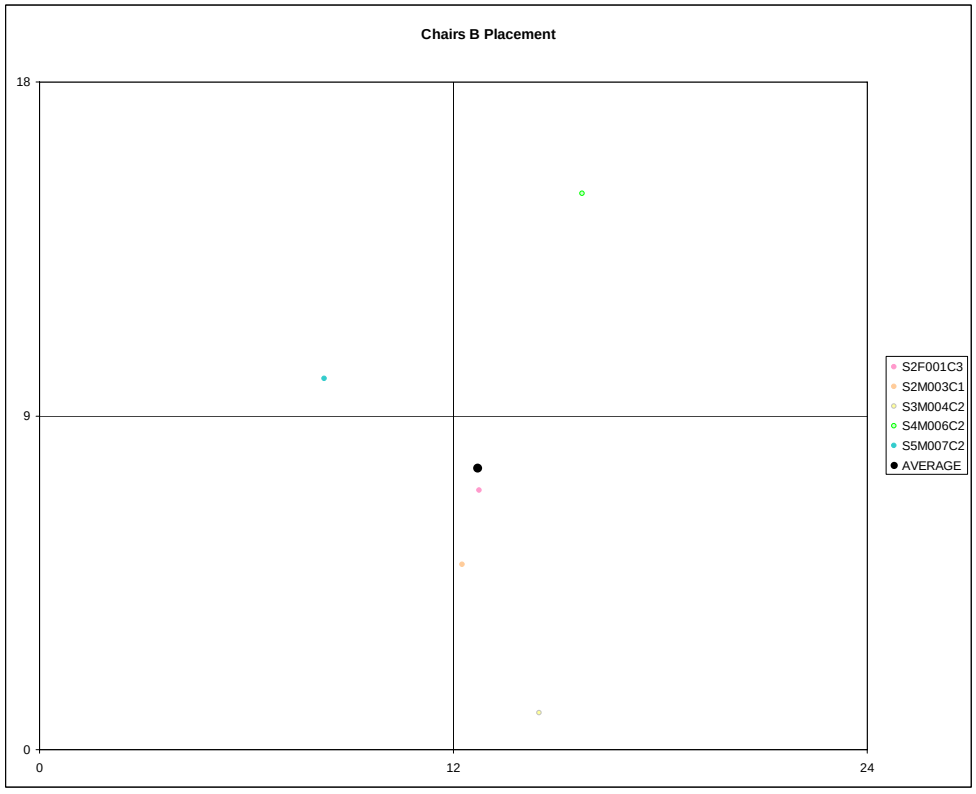
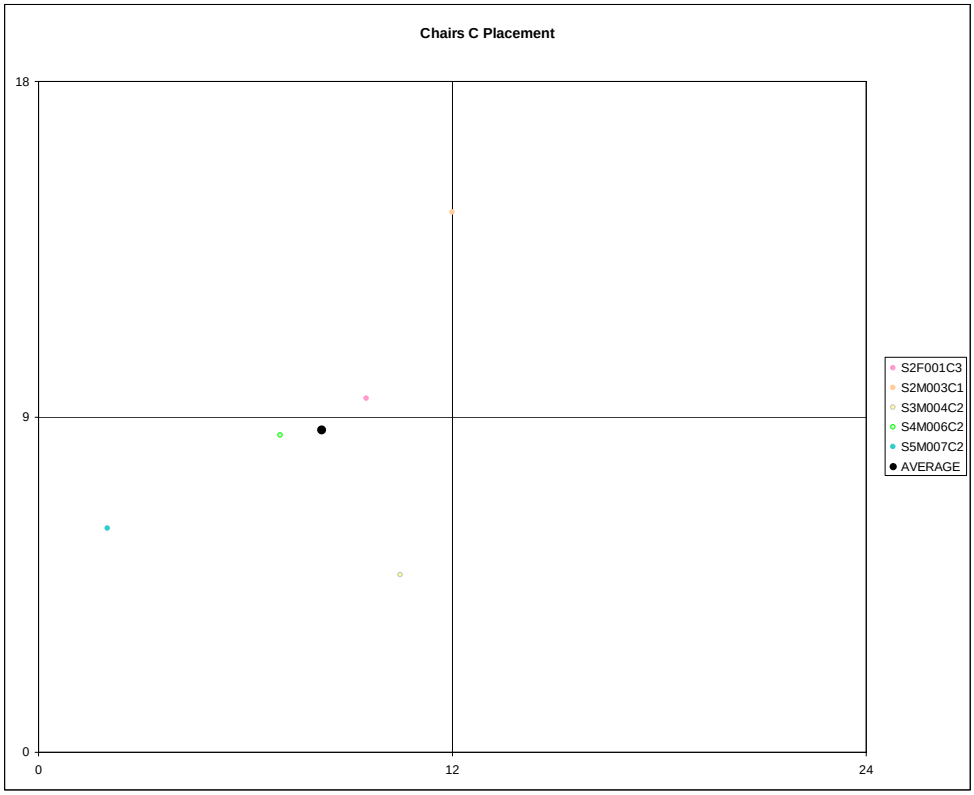


Figure 45. Chair Product Placement by Product, with Averages.



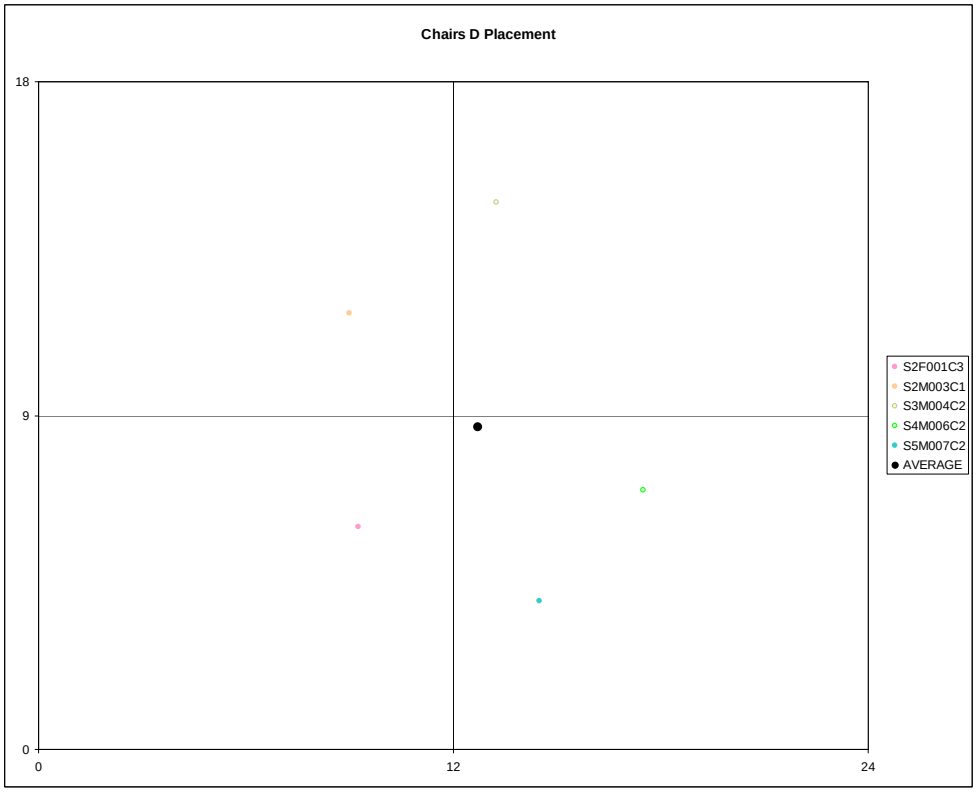
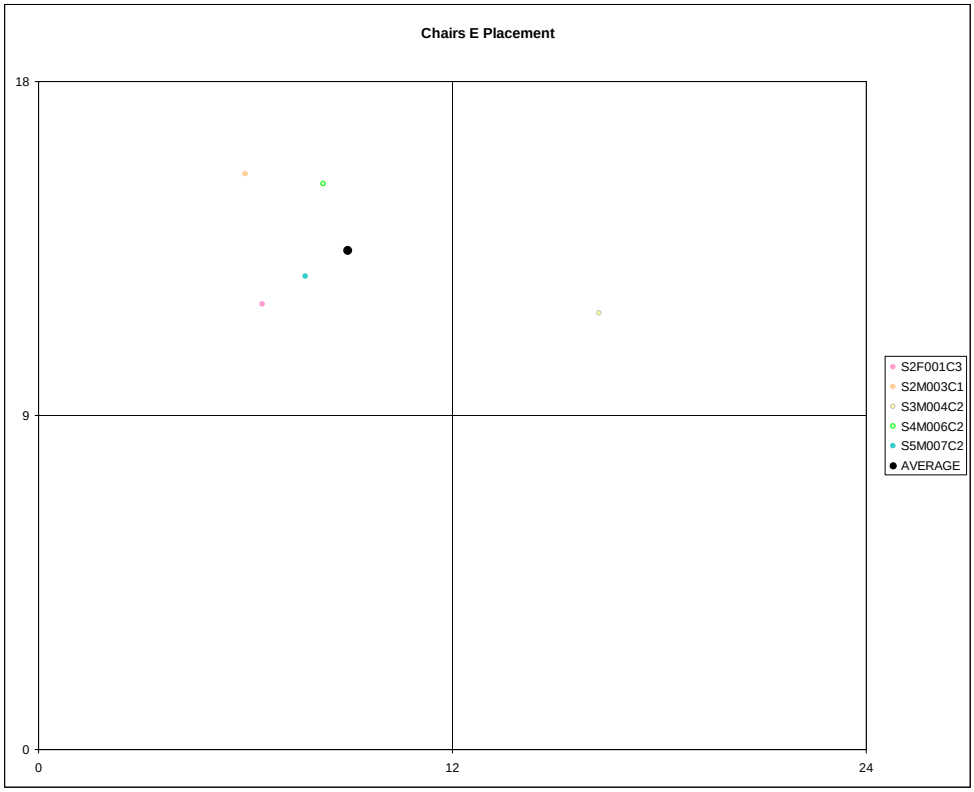


Figure 45. Continued.



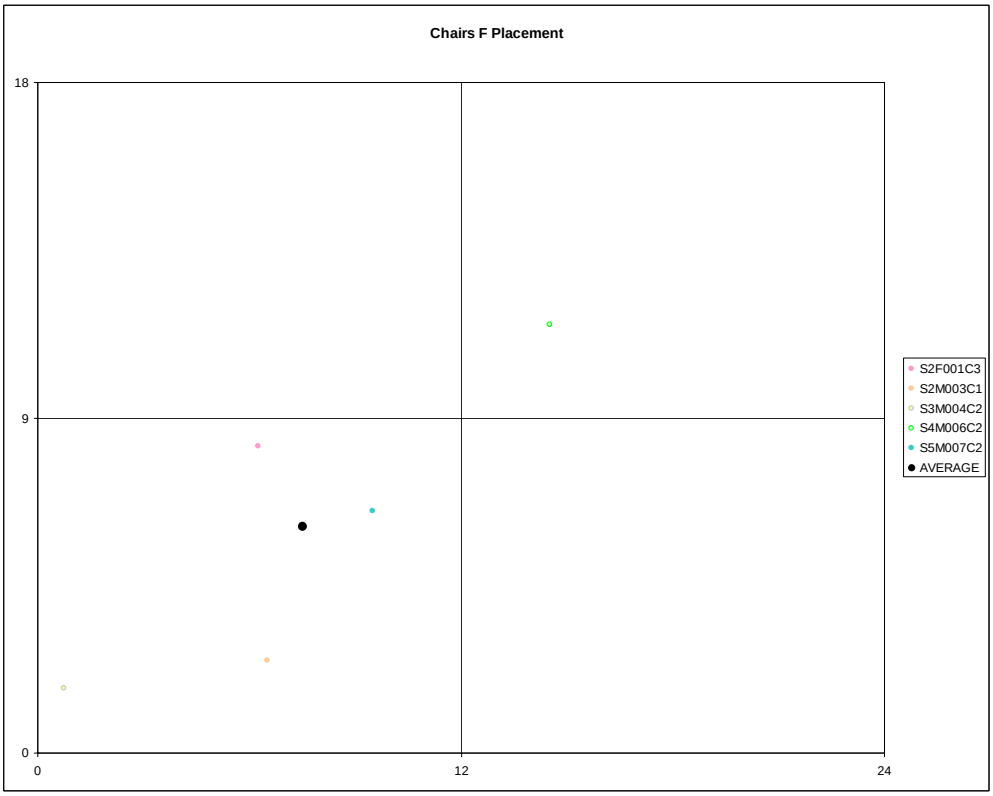
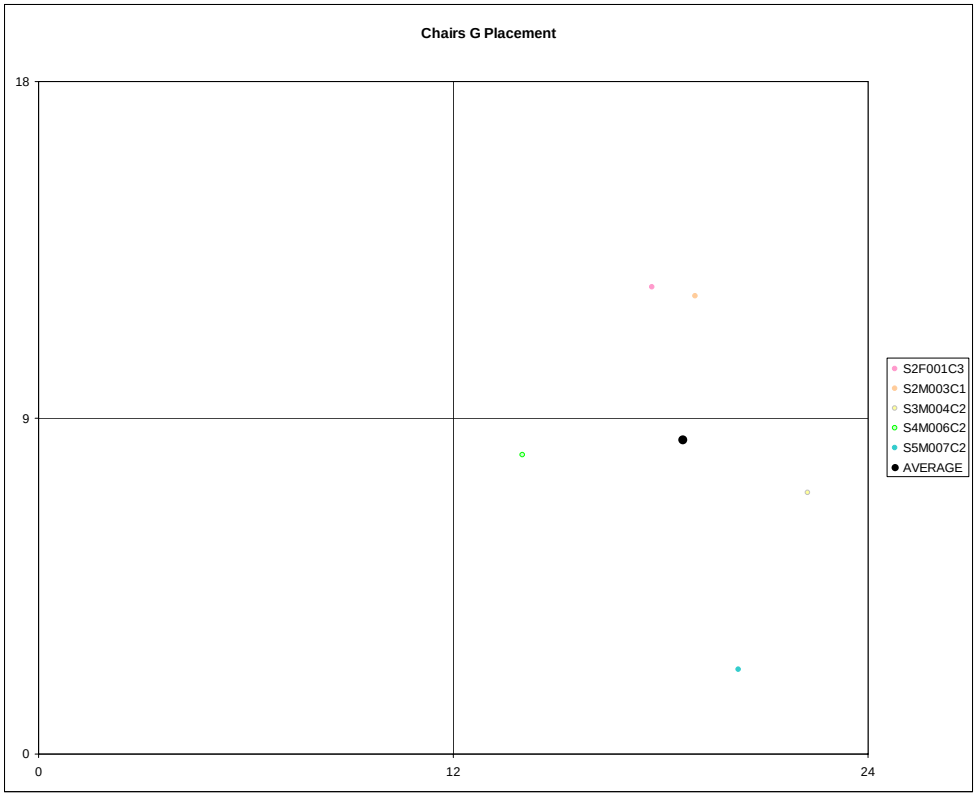


Figure 45. Continued.



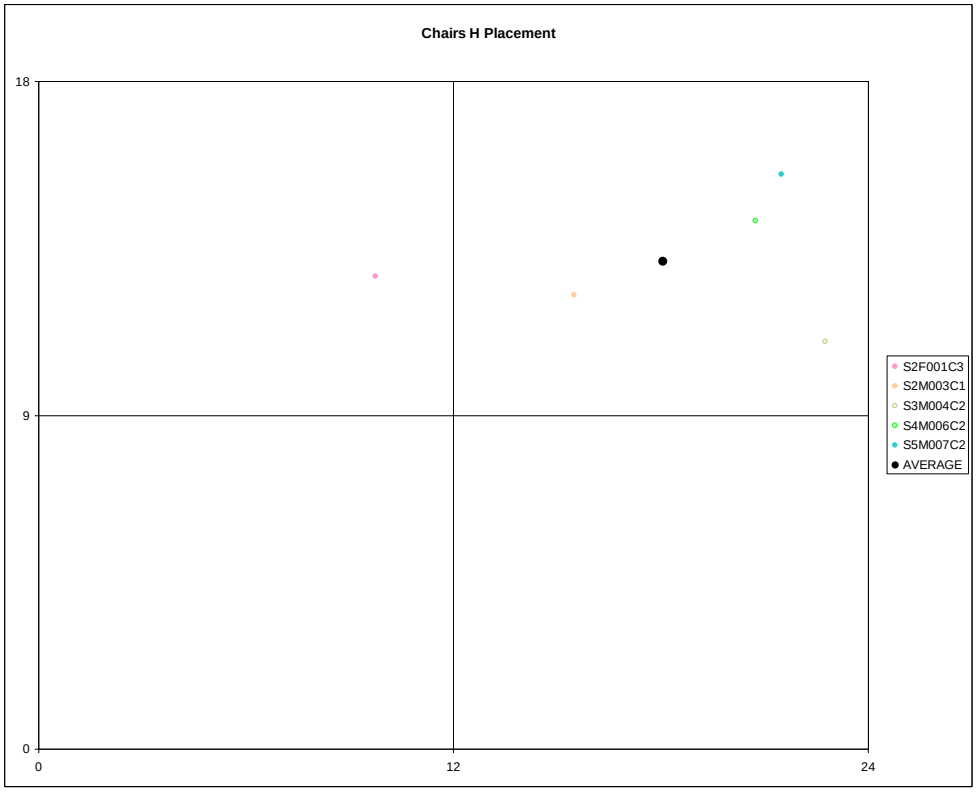
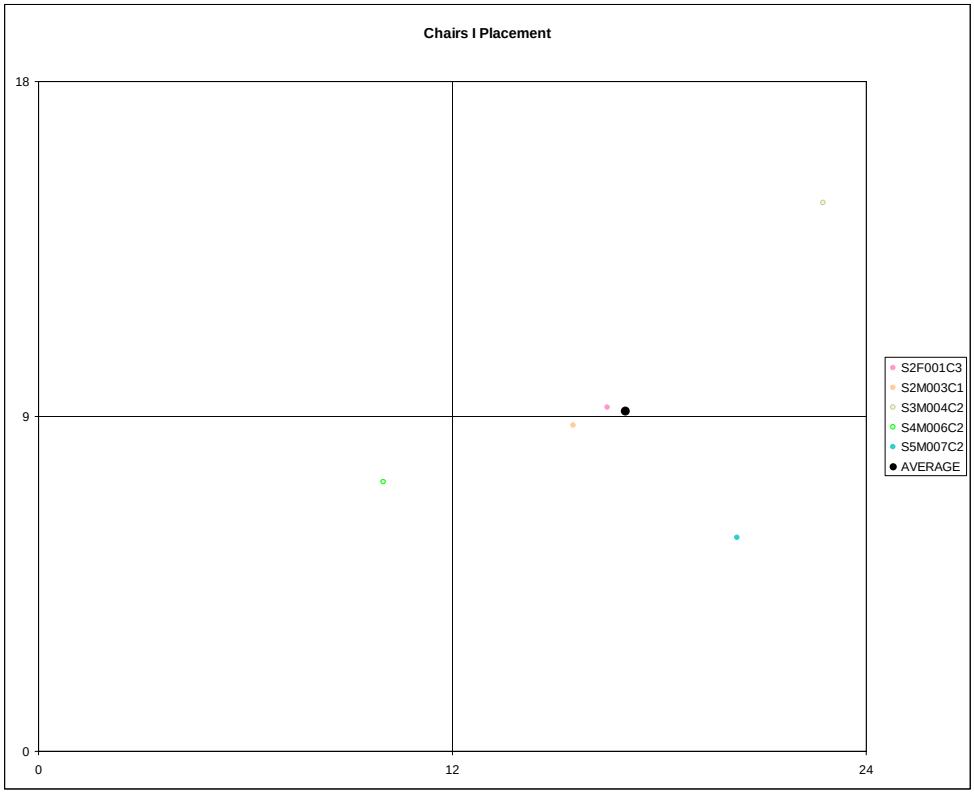


Figure 45. Continued.



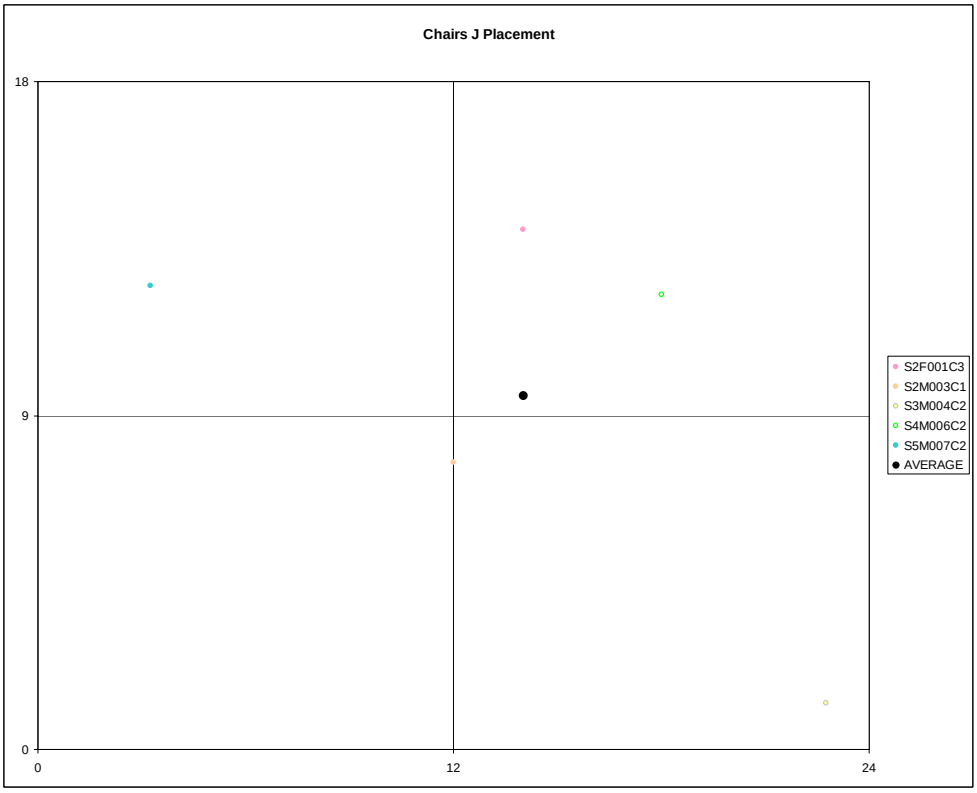
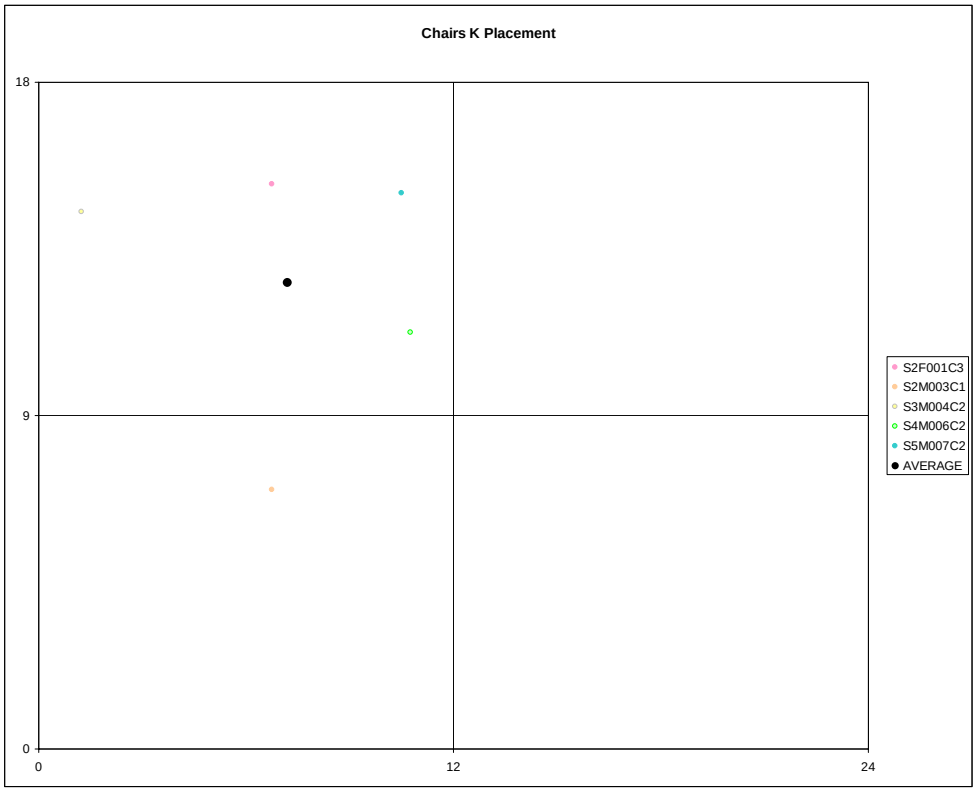


Figure 45. Continued.



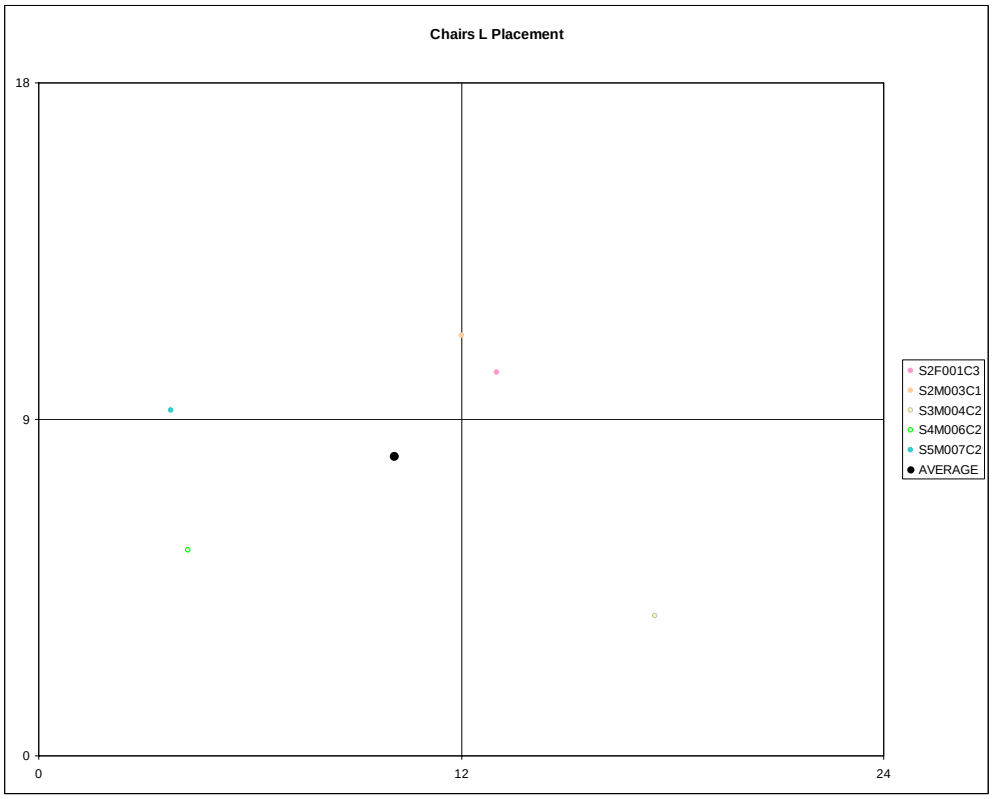


Figure 45. Continued.

Table 44. Chairs Ranked by Normalized Scores.

	Chair	Score
H		2.792788
G		1.392021
I		1.24944
E		0.761755
J		0.677558
D		0.09773
K		0.076679
B		-0.25916
L		-0.73748
C		-0.97098
F		-1.96203
A		-3.11832

Table 45. Spatula Vocabulary Tally for All Products.

	A		B		C		D		E		F		G		H		I		J		K		L	
1	Boring	1	Amorphous	1	Beautiful	2	Active	1	Active	1	Beautiful	1	Boring	1	Busy	1	Amorphous	1	Boring	1	Active	1	Aggressive	1
2	Comfortable	1	Bright	2	Clean	1	Disassemable	1	Beautiful	1	Dull	2	Calm	1	Comfortable	2	Complex	6	Calm	1	Bright	1	Busy	1
3	Disordered	1	Clean	1	Durable	2	Durable	4	Dull	1	Durable	1	Clean	1	Curved	2	Dull	1	Dull	1	Disassemblable	1	Complex	2
4	Efficient	1	Decorative	3	Efficient	2	Easy to Use	1	Expensive	1	Functional	2	Comfortable	1	Disassembable	1	Efficient	1	Feminine	1	Easy to Use	1	Hard to Use	2
5	Expensive	1	Feminine	1	Elegant	2	Elegant	1	Feminine	1	Geometric	1	Dull	1	Durable	1	Expensive	1	Handmade	2	Flexible	2	Heavy	2
6	Flexible	1	Flexible	1	Expensive	2	Expensive	2	Geometric	2	Hard to Use	2	Easy to Use	2	Easy to Use	1	Fragile	3	Light	1	Fragile	1	Masculine	1
7	Low Quality	1	High Quality	1	Feminine	1	Flexible	1	healthy	1	Heavy	2	Efficient	1	Flexible	1	Hard to Use	2	Masculine	1	Fun	3	Plastic	1
8	Mechanical	1	Ornate	1	Functional	1	Healthy	1	High Quality	1	Inexpensive	1	Elegant	1	Functional	1	Low Quality	1	Minimalist	2	Low Quality	3	Recyclable	1
9	Plastic	3	Over-comfortable	1	Glossy	4	High Quality	2	Masculine	1	Metal	2	Functional	3	High Quality	1	Mechanical	3	Natural	7	Modern	1	Synthetic	1
10	Recyclable	2	Plastic	2	Heavy	1	Masculine	1	Metal	3	Minimalist	3	Glossy	1	Imperfect	1	Metal	1	Old	3	Ornate	1	Ugly	2
11	Sensible	2	Recyclable	2	Metal	4	Metal	2	Minimalist	1	Old	1	Imperfect	1	Inexpensive	2	Modern	1	Organic	6	Plastic	3		
12	Synthetic	1	Refined	1	Modern	5	Modern	2	Modern	3	Outdated	2	Inexpensive	2	Low Quality	1	Recyclable	1	Outdated	1	Playful	3		
13	Uncomfortable	1	Rounded	1	Professional	3	Professional	3	Organic	1	Pure	2	Metal	1	Plastic	2	Uncomfortable	1	Pure	4	Recyclable	1		
14			Soft	1	Refined	1	Recyclable	1	Recyclable	1	Raw	1	Recyclable	1	Professional	1	Unique	1	Raw	2	Soft	1		
15			Synthetic	4	Simple	3	Redined	1	Refined	1	Recyclable	2	Rugged	1	Recyclable	2			Recyclable	2	Synthetic	3		
16			Ugly	3	Sleek	3	Rigid	2	Rugged	1	Rigid	2	Sensible	2	Sleek	1			Rugged	1	Ugly	2		
17			Uncomfortable	1	Solid	3	Sensible	1	Sensible	1	Rugged	2	Simple	1	Soft	1			Simple	3				
18			Unique	1			Simple	1	Sleek	2	Simple	3			Synthetic	3			Solid	1				
19							Sleek	1			Solid	1							Wood	8				
20							Unique	1			Uncomfortable	1												
21											Unique	1												
	Total	17	Total	28	Total	40	Total	30	Total	24	Total	35	Total	22	Total	25	Total	24	Total	48	Total	28	Total	14

Table 46. Mug Vocabulary Tally for All Products.

	A		B		C		D		E		F		G		H		I		J		K		L	
1	Handmade	3	Wood	3	Minimalist	6	Unique	5	Ornate	8	Outdated	2	Inexpensive	6	Fragile	6	Playful	4	Metal	5	Expensive	4	Complex	6
2	Natural	3	Natural	2	Simple	4	Hard to Use	3	Heavy	6	Modern	2	Toxic	4	High Quality	3	Juvenile	3	Sleek	3	Decorative	4	Mechanical	5
3	Organic	2	Handmade	2	Pure	4	Ugly	3	Old	5	Elegant	2	Synthetic	3	Feminine	3	Plastic	2	Durable	3	Elegant	2	Active	4
4	Imperfect	2	Rugged	1	Clean	3	Uncomfortable	3	Metal	3	Efficient	2	Low Quality	3	Old	3	Geometric	2	Pure	3	Ornate	2	Hard to Use	2
5	Ugly	2	Organic	1	Solid	2	Organic	3	Masculine	3	Plastic	1	Functional	2	Elegant	2	Fun	2	Simple	3	Calm	1	Busy	2
6	Boring	2	Unique	1	Fragile	2	Raw	2	Manmade	3	Boring	1	Boring	2	Refined	2	Ugly	2	Modern	2	Sensible	1	Manmade	1
7	Dirty	1	Synthetic	1	Dull	1	Rugged	2	Expensive	2	Rigid	1	Unhealthy	2	Outdated	2	Synthetic	1	Hard	2	Comfortable	1	Functional	1
8	Old	1	Rough	1	Easy to Use	1	Amorphous	2	Decorative	2	Sensible	1	Clean	2	Curved	2	Rugged	1	Professional	2	Glossy	1	Modern	1
9	Unhealthy	1	Decorative	1	Functional	1	Rough	1	Busy	2	Feminine	1	Efficient	1	Bright	1	Comfortable	1	High Quality	2	Bright	1	Expensive	1
10	Low Quality	1	Fun	1	High Quality	1	Useless	1	Beautiful	1	Sleek	1	Light	1	Heirloom	1	Rounded	1	Glossy	1	Fragile	1	Plastic	1
11	Outdated	1			Calm	1	Dirty	1	Durable	1	Professional	1	Manmade	1	Light	1	Disordered	1	Rugged	1	Curved	1		
12	Easy to Use	1			Sleek	1	Unhealthy	1	Ugly	1	Functional	1	Sensible	1	Decorative	1	Retarded	1	Solid	1				
13	Manmade	1			Professional	1	Masculine	1	Solid	1	Unique	1	Dull	1	Ornate	1	Modern	1	Rigid	1				
14	Solid	1			Modern	1	Soft	1			Comfortable	1	Ugly	1			Flexible	1	Minimalist	1				
15	Rough	1					Manmade	1			Simple	1					Hard to Use	1	Efficient	1				
16	Dull	1					Playful	1			Contrast	1					Light	1	Functional	1				
17							Handmade	1									Unique	1	Bright	1				
18							Decorative	1									Durable	1	Refined	1				
19																	Recyclable	1	Sensible	1				
20																	Easy to Use	1						
21																	Functional	1						
		24		14		29		33		38		20		30		28		30		35		19		24

Table 47. Boot Vocabulary Tally for All Products.

	A		B		C		D		E		F		G		H		I		J		K		L	
1	Soft	4	Functional	5	Synthetic	3	Active	2	Rugged	5	Bright	3	Uncomfortable	5	Durable	3	Rugged	4	Organic	5	Durable	3	High Quality	5
2	Comfortable	3	Durable	4	Ugly	2	Ugly	2	Masculine	4	Modern	2	Outdated	3	Masculine	3	Active	3	Recyclable	4	Rugged	3	Expensive	5
3	Outdated	2	Rugged	3	Plastic	2	Comfortable	1	Durable	3	Playful	2	Organic	3	Aggressive	3	Synthetic	2	Ugly	2	Functional	3	Elegant	4
4	Manmade	2	Plastic	1	Curved	1	Masculine	1	Rough	2	Sensible	2	Ugly	2	Rugged	2	Comfortable	2	Handmade	2	Plastic	2	Refined	3
5	Dull	2	Heavy	1	Modern	1	Amorphous	1	Rigid	2	Active	2	Decorative	2	Solid	2	Durable	2	Pure	2	Synthetic	2	Masculine	3
6	Natural	2	Ugly	1	Expensive	1	Unique	1	Simple	1	Comfortable	2	Natural	1	Heavy	2	High Quality	2	Natural	2	Uncomfortable	2	Sleek	3
7	Low Quality	1	High Quality	1	Comfortable	1	Expensive	1	Functional	1	Fun	2	Rough	1	Rigid	2	Masculine	1	Flexible	1	Ugly	2	Professional	2
8	Light	1	Minimalist	1	Low Quality	1	Modern	1	Solid	1	Flexible	2	Expensive	1	Dirty	1	Functional	1	Comfortable	1	Glossy	2	Glossy	1
9	Organic	1	Fun	1	Retarded	1	Curved	1	Heavy	1	Unique	2	Ornate	1	Ugly	1	Solid	1	Manmade	1	Recyclable	1	Functional	1
10	Easy to Use	1	Playful	1	Rounded	1	Soft	1	Professional	1	Efficient	1	Fragile	1	Functional	1	Aggressive	1	Soft	1	Easy to Use	1	Beautiful	1
11	Boring	1	Efficient	1	Complex	1	Rough	1			Easy to Use	1	Old	1	Modern	1	Healthy	1	Simple	1	Heavy	1	Simple	1
12	Raw	1	Manmade	1	Heavy	1	Inexpensive	1			Functional	1	Beautiful	1	High Quality	1	Hard	1	Complex	1	Pure	1	Modern	1
13	Inexpensive	1	Rough	1	Boring	1	Dull	1			Dull	1	Feminine	1	Recyclable	1			Geometric	1	High Quality	1	Minimalist	1
14	Rounded	1	Synthetic	1	Sleek	1	Fun	1			Soft	1							Passive	1	Dirty	1		
15	Feminine	1	Masculine	1							Low Quality	1							Submissive	1	Minimalist	1		
16																			Modern	1	Simple	1		
17																			Raw	1	Old	1		
18																					Boring	1		
19																					European	1		
20																					Fun	1		
21																					Playful	1		
22																					Unique	1		
23																					Decorative	1		
24																					Amorphous	1		
25																					Toxic	1		
26																					Active	1		
27																					Masculine	1		
		24		24		18		16		21		25		23		23		21		28		38		31

Figure 48. Lamp Vocabulary Tally for All Products.

	A		B		C		D		E		F		G		H		I		J		K		L	
1	Mechanical	4	Playful	5	Recyclable	8	Beautiful	3	Fun	5	Metal	5	Ornate	6	Modern	3	Ugly	2	Outdated	4	Functional	3	Outdated	2
2	Minimalist	4	Plastic	4	Handmade	4	Geometric	3	Bright	4	Sleek	3	Decorative	4	Elegant	2	Masculine	1	Dull	3	Dull	2	Amorphous	2
3	Functional	2	Organic	3	Low Quality	3	Calm	2	Playful	3	Elegant	2	Expensive	3	Clean	2	High Quality	1	Boring	2	Efficient	2	Bright	2
4	Flexible	2	Juvenile	2	Raw	3	Solid	2	Unique	3	Curved	2	Old	2	Sleek	2	Boring	1	Old	2	Masculine	2	Toxic	2
5	Sleek	2	Durable	2	Rugged	2	Modern	1	Soft	2	Heavy	2	Elegant	2	Beautiful	2	Organic	1	Feminine	1	Bright	1	Ugly	1
6	Complex	1	Fun	2	Natural	2	Fun	1	Easy to Use	1	Durable	1	Fragile	2	Simple	2	Ornate	1	Low Quality	1	Boring	1	Geometric	1
7	Expensive	1	Amorphous	2	Inexpensive	2	Unique	1	Decorative	1	Boring	1	Feminine	2	Pure	2	Curved	1	Glossy	1	Inexpensive	1	Organic	1
8	Metal	1	Curved	1	Unique	1	Soft	1	Feminine	1	Masculine	1	Busy	1	Organic	2	Old	1	Uncomfortable	1	High Quality	1	Rigid	1
9	Durable	1	Rounded	1	Sensible	1	Simple	1	Clean	1	Glossy	1	Complex	1	Soft	1	Elegant	1	Organic	1	Minimalist	1	Metal	1
10	Masculine	1	High Quality	1	Organic	1	High Quality	1	Aggressive	1	Professional	1	Uncomfortable	1	Professional	1	Decorative	1	Busy	1	Plastic	1	Retro	1
11	Rigid	1	Flexible	1	Functional	1	Pure	1	Ugly	1	Refined	1	Calm	1	Calm	1	Heavy	1	Complex	1	Sensible	1	Imperfect	1
12	Refined	1	Unique	1	Minimalist	1	Natural	1	Juvenile	1	Glossy	1	Ugly	1	Comfortable	1	Durable	1	Hard to Use	1	Light	1	Unhealthy	1
13	Modern	1	Active	1	Elegant	1	Glossy	1	Syntheitc	1	Simple	1	Dull	1	Natural	1			Heavy	1	Low Quality	1	Curved	1
14	Unique	1	Busy	1	Modern	1	Decorative	1	Modern	1					Straight	1					Mechanical	1	Inexpensive	1
15	Active	1			Efficient	1	Feminine	1							Masculine	1					Modern	1	Passive	1
16	Efficient	1			Manmade	1	Inexpensive	1							Bright	1							Playful	1
17	Sensible	1													Geometric	1							Fun	1
18	Professional	1													Ornate	1								
19	Boring	1																						
20		28		27		33		22		26		22		27		27		13		20		20		21

Table 49. Chair Vocabulary Tally for All Products.

	A		B		C		D		E		F		G		H		I		J		K		L	
1	Ugly	2	Minimalist	4	Playful	5	Old	2	Professional	5	Uncomfortable	2	Wood	4	Metal	5	Wood	4	Minimalist	4	Mechanical	4	Plastic	6
2	Uncomfortable	2	Modern	3	Light	3	Decorative	2	Functional	2	Expensive	2	Natural	3	Recyclable	2	High Quality	3	Modern	3	Comfortable	2	Curved	4
3	Manmade	2	Geometric	2	Juvenile	3	Outdated	2	Comfortable	2	Aggressive	1	Organic	3	Sensible	2	Handmade	3	Rigid	2	Functional	2	Fun	2
4	Toxic	2	Sleek	1	Plastic	2	Busy	2	Recyclable	1	Unhealthy	1	Handmade	2	Easy to Use	1	Ornate	2	Simple	2	Hard to Use	1	Glossy	2
5	Rugged	1	Inexpensive	1	Fun	2	Feminine	1	Complex	1	Hard to Use	1	Rough	2	Sleek	1	Masculine	2	Plastic	1	Complex	1	Amorphous	2
6	Decorative	1	Recyclable	1	Low Quality	2	Boring	1	Light	1	Ugly	1	Raw	2	Inexpensive	1	Old	2	Boring	1	Light	1	Playful	1
7	Rough	1	Straight	1	Synthetic	2	Sensible	1	Plastic	1	Complex	1	Calm	1	Durable	1	Elegant	2	Dull	1	Plastic	1	Organic	1
8	Retarded	1	Clean	1	Comfortable	1	Beautiful	1	Metal	1	Rough	1	Rugged	1	Minimalist	1	Outdated	2	Recyclable	1	Metal	1	Recyclable	1
9	Aggressove	1	Simple	1	Manmade	1	Pure	1	Efficient	1	Decorative	1	Imperfect	1	Clean	1	Solid	2	High Quality	1	Easy to Use	1	Synthetic	1
10	Fragile	1	Hard	1	Rounded	1	Professional	1	Refined	1	Modern	1	Recyclable	1	Functional	1	Heavy	2	Metal	1	Low Quality	1	Sleek	1
11	Synthetic	1	Rigid	1	Bright	1	Manmade	1	Sensible	1	Manmade	1	Manmade	1	Professional	1	Expensive	2	Clean	1	Simple	1	Modern	1
12	Unique	1			Toxic	1	Complex	1	Flexible	1	Geometric	1					Hard	1	Hard	1			Manmade	1
13	Unhealthy	1			Amorphous	1	Comfortable	1	Mechanical	1	Mechanical	1					Durable	1	Glossy	1			Hard	1
14	Fiberglass	1					Wood	1			Sleek	1					Beautiful	1	Elegant	1			Rigid	1
15	Old	1					Refined	1			Busy	1					Decorative	1	Sleek	1			Rounded	1
16							Ornate	1			Straight	1					Comfortable	1	Curved	1			Outdated	1
17							Soft	1									Manmade	1					Bright	1
18							Ugly	1									Complex	1					Unique	1
19																							Decorative	1
20																							Aggressive	1
		19		17		25		22		19		18		21		17		33		23		16		31

Table 50. Most Frequently Used Terms in Aggregate and by Category.

Term	Freq
Modern	42
Functional	38
Recyclable	38
Ugly	37
Metal	36
Plastic	36
Durable	35
Organic	35
Rugged	31
Simple	31

Lamps		Mugs		Boots		Chairs		Spatulas	
Fun	9	Ornate	11	Rugged	17	Plastic	11	Recyclable	16
Organic	9	Decorative	9	Durable	15	Minimalist	9	Metal	13
Playful	9	Fragile	9	Masculine	14	Wood	9	Modern	12
Bright	8	Old	9	Functional	13	Manmade	8	Synthetic	12
Elegant	8	Ugly	9	Ugly	12	Metal	8	Plastic	11
Modern	8	Unique	9	Comfortable	10	Modern	8	Simple	11
Ornate	8	Metal	8	High Quality	10	Comfortable	7	Complex	8
Recyclable	8	Simple	8	Organic	9	Professiona	7	Durable	8
Decorative	7	Expensive	7	Active	8	Recyclable	7	Wood	8
Metal	7	Functional	7	Expensive	8	Decorative	6	Expensive	7

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